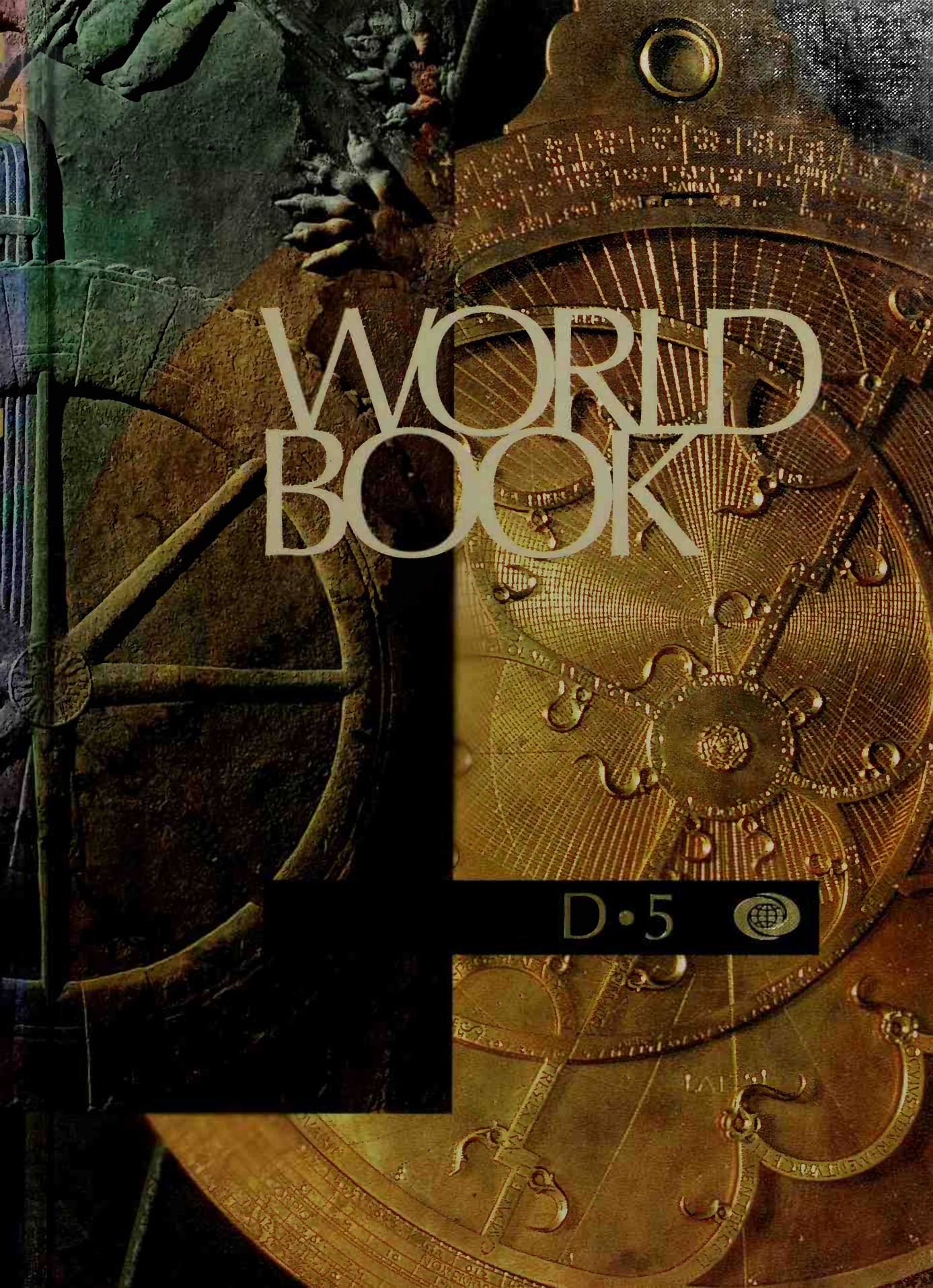
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Dd

D is the fourth letter of our alphabet. It was also the fourth letter in the alphabet used by the Semites, who once lived in Syria and Palestine. They named it *daleth,* a word that meant *door.* It is believed that this word came from one of the *hieroglyphs* (picture symbols) the ancient Egyptians used. They drew a picture of a door with panels. See **Alphabet.**

Uses. *D* or *d* ranks as about the tenth most frequently used letter in books, newspapers, and other printed material in English. When used on a report card, *D* usually means poor work or near failure in a school subject. In music, it names one note of the scale. As an abbreviation, *D* stands for the isotope *deuterium* in chemistry, for *electric displacement* in electronics, and for *500* in the Roman numeral system. The symbol *d* denotes *drag* in aeronautics, and the fourth known quantity in algebra. The symbol *D* or *d* stands for *diameter* in mathematics and physics, or a wider-than-average shoe.

Pronunciation. In English, a person pronounces *d* with the tongue touching the roof of the mouth just back of the teeth. In French, Dutch, and Italian, the tongue touches the upper front teeth. In German, a *d* at the beginning of a word, followed by a vowel, resembles the English *d* sound. Otherwise, it usually has a *t* sound. The Spanish *d* is expressed more softly than in English when it is at the beginning of a word. Elsewhere, it has a *th* sound, similar to *the* in English, not the *th* of *thin.* See **Pronunciation.**

Marianne Cooley

Development of the letter D

The ancient Egyptians drew this symbol of a door with panels about 3000 B.C. The Semites adapted the symbol and named it *daleth,* their word for *door.*

The Phoenicians used a triangle in their alphabet about 1000 B.C.

The Greeks, about 600 B.C., shaped the letter as an equilateral triangle. They called their letter *delta.*

The Romans rounded the letter and gave it its capital form about A.D. 114.

The small letter d developed about A.D. 500 from Roman writing. Monks who copied manuscripts reshaped the letter during the 800's. By about 1500, the letter had developed its present shape.

Special ways of expressing the letter D

International Morse Code

Braille

International Flag Code

Semaphore Code

Sign Language Alphabet

Common forms of the letter D

Dd *Dd*

Handwritten letters vary from person to person. *Manuscript* (printed) letters, *left,* have simple curves and straight lines. Cursive letters, *right,* have flowing lines.

Dd *Dd*

Roman letters have small finishing strokes called *serifs* that extend from the main strokes. The type face shown above is Baskerville. The italic form appears at the right.

Dd *Dd*

Sans-serif letters are also called *gothic letters.* They have no serifs. The type face shown above is called Futura. The italic form of Futura appears at the right.

D

Computer letters have special shapes. Computers can "read" these letters either optically or by means of the magnetic ink with which the letters may be printed.

D-day is the term for a secret date on which a military operation is to begin. Peacetime planning of military operations is also based on hypothetical D-days. Terms such as *D-plus-3* (three days after initial attack) and H-hour (the hour of an attack) are used to plan the sequence of operations. The term *D-day* became current during World War II (1939-1945), when it defined dates set for Allied landings on enemy-held coasts. The most famous D-Day is June 6, 1944, when the Allies invaded Normandy. For detailed information and a map and pictures, see **World War II** (D-Day). John W. Gordon

Da Nang, *dahn ahng* (pop. 370,670), is one of the largest cities in Vietnam. Da Nang is also called Tourane (*too RAHN*). The city's location on the South China Sea has made it an important trading center since the 1600's (see **Vietnam** [map]). The city produces soap and textiles.

Da Nang became a city of South Vietnam in 1954, when that country was created. Da Nang was a key city during the Vietnam War (1957-1975) because of its location near North Vietnam. United States military forces established bases there, and the city became a favorite target of the North Vietnamese forces. The North Vietnamese Communists took control of South Vietnam in 1975. They unified North and South Vietnam into the single nation of Vietnam in 1976. David P. Chandler

Dacca. See **Dhaka**.

Dachau, *DAH kow,* was the first permanent concentration camp set up in Germany by the Nazis. It became the model for all other Nazi concentration camps. The facility stood at the edge of the town of Dachau, near Munich, in southeastern Germany. Dachau was built in 1933 to hold Jews and political prisoners. After 1942, many of the prisoners were used as slave labor on farms or in weapons factories near the camp.

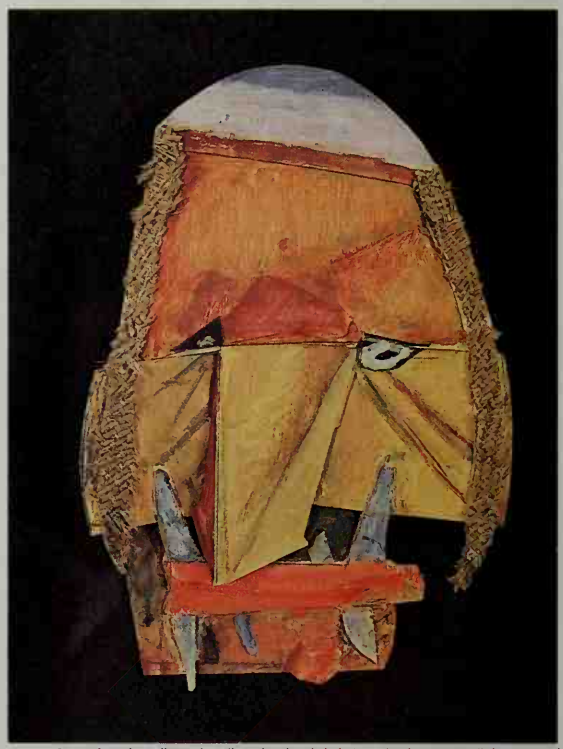
At Dachau, the Nazis performed brutal medical experiments on more than 3,500 prisoners, most of whom died. About 28,500 other prisoners were murdered or died of starvation and disease. United States forces found about 10,000 dead bodies and more than 32,000 starving prisoners when they liberated the camp on April 29, 1945. Charles W. Sydnor, Jr.

Dachshund, *DAHKS hund,* is a dog known for its long, low-slung body and short legs. The breed originated in Germany, where it was trained to hunt badgers. The word *dachshund* is German for *badger hound.* The dachshund has a cone-shaped head, a slim, tapering muzzle, and long, drooping ears. Its front legs are slightly curved. Its glossy coat usually is black or tan, but it may be red, yellow, gray, spotted, or striped. Many dachshunds have short, smooth hair. Two other varieties are the long-haired, with long, silky hair; and the wire-haired, with a rough coat. The dachshund makes a good watchdog and a wonderful pet. See also **Dog** (picture: Hounds). Critically reviewed by the Dachshund Club of America

WORLD BOOK photo

A dachshund has a long body and short legs.

Dadaism, *DAH duh ihz uhm,* a protest movement in the arts, was formed in 1916 by a group of artists and poets in Zurich, Switzerland. The dadaists reacted to what they believed were outworn traditions in art and to the evils that they saw in society. They tried to shock and provoke the public with outrageous demonstrations, cabaret performances, poetry recitals, and art exhibits. Much dada art was playful and highly experimental. According to one report, *dada,* the French word for *hobbyhorse,* was chosen because it was nonsensical.



Oriental Mask, a collage of cardboard and sackcloth; Janco/Dada Museum, Tel Aviv, Israel

Dada art expressed its rebellion against traditional artistic styles through such experimental forms as the *collage.* Dada artist Marcel Janco made this collage mask about 1917.

Dada founders included Romanian poet Tristan Tzara, French artist Jean Arp, Romanian artist Marcel Janco, and German poet Hugo Ball. Later members included French artist Francis Picabia, French poets Louis Aragon and André Breton, and German artists Max Ernst and Kurt Schwitters. Though not strictly a member of dada, French artist Marcel Duchamp was working in the dada spirit as early as 1913 (see **Duchamp, Marcel**). Dada assumed its most radical and political character in Ger-

many, where World War I (1914-1918) had led to severe economic hardship. The appearance of dada in Paris led to the development of surrealism, another protest movement in the arts, in 1924. Stephen C. Foster

See also Arp, Jean; Breton, André; Ernst, Max; Painting (Dadaism); Ray, Man.

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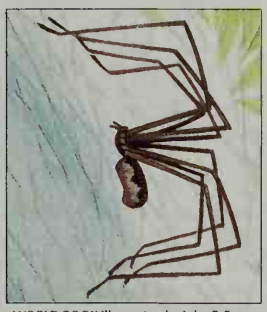
Daddy longlegs is a popular name in North America for a harmless, long-legged creature related to the spider. Its legs are bent and its body hangs close to the ground. It is not an insect, but an *arachnid* (see Arachnid). Another name for it is *harvestman.*



WORLD BOOK illustration by John F. Eggert

Daddy longlegs

Daddy longlegs prey on small insects. They also eat dead insects and fallen fruit. When disturbed, many species of daddy longlegs can give off a bad odor, but they do not bite. In the tropics, some species gather in great enough numbers to cover a small bush. If disturbed, all the daddy longlegs will shake violently, causing the entire bush to move.

In England, the *crane fly* is called *daddy longlegs.* The crane fly is an insect that has wings and looks much like a large mosquito, but it does not bite.

Scientific classification. The harvestman belongs to the class Arachnida. It makes up the order Opiliones. The crane fly belongs to the class Insecta, order Diptera, and family Tipulidae.

Edwin W. Minch

Daedalus, *DEHD uh luhs,* in Greek mythology, was a skilled Athenian craftsman and inventor. Daedalus took his nephew Perdix, or Talos, as an apprentice. Perdix proved to be such a brilliant craftsman that Daedalus killed him in a jealous rage. After his crime, Daedalus fled to Crete. Minos, the king of Crete, hired Daedalus, who created many ingenious inventions while in the ruler's service. His work included the *labyrinth,* a maze-like building, which imprisoned a monster called the Minotaur (see Minotaur).

Daedalus helped Minos' daughter Ariadne elope with Theseus, the slayer of the Minotaur. As punishment for the crime, Minos imprisoned Daedalus and his young son, Icarus, in the labyrinth. In order to escape, Daedalus made two pairs of wings from feathers, wax, and thread. Daedalus and Icarus used the wings to fly from Crete. However, Icarus flew too close to the sun. The wax in his wings melted and he plunged to his death in the sea. Minos pursued Daedalus to Sicily. According to one story, Daedalus killed the king by scalding him in a specially constructed bathtub. Justin M. Glenn

See also Airplane (picture: An ancient Greek story).

Daffodil is a type of garden flower with petals surrounding a cup-shaped center. Daffodils are usually white or yellow, but they may also be shades of cream, orange, or pink. Daffodils are native to Europe and northern Africa, but they can adapt to a wide range of growing conditions. Some daffodils are also known as *jonquils.*

WORLD BOOK illustration by Robert Hynes

The daffodil is a yellow narcissus that blooms in the early spring. The best-known daffodil is the trumpet narcissus, *above.*

Growers have developed thousands of *cultivars* (cultivated varieties) of daffodils. The best-known cultivars are those of the *trumpet narcissus,* also called the *trumpet daffodil.* This daffodil's *trumpet,* or cup, is equal to or longer than the petals that surround it. The trumpet narcissus produces only one flower on each stem. However, other types of daffodils may produce more than one flower per stem.

Daffodils grow from bulbs, which are planted in the fall. In flower beds, large bulbs should be planted about 2 to 6 inches (5 to 15 centimeters) apart and about 4 to 6 inches (10 to 15 centimeters) deep. Smaller bulbs can be placed closer together and somewhat less deep. Daffodils have five or six narrow leaves that grow up to 16 inches (41 centimeters) long. Most bulb growth occurs after flowering. Thus, the leaves, which make food for growth, should not be removed for at least 10 weeks after the flowers have faded. Daffodil bulbs are poisonous if eaten.

Scientific classification. Daffodils are in the amaryllis family, Amaryllidaceae. Trumpet narcissuses are cultivars of the species *Narcissus pseudonarcissus.* August A. De Hertogh

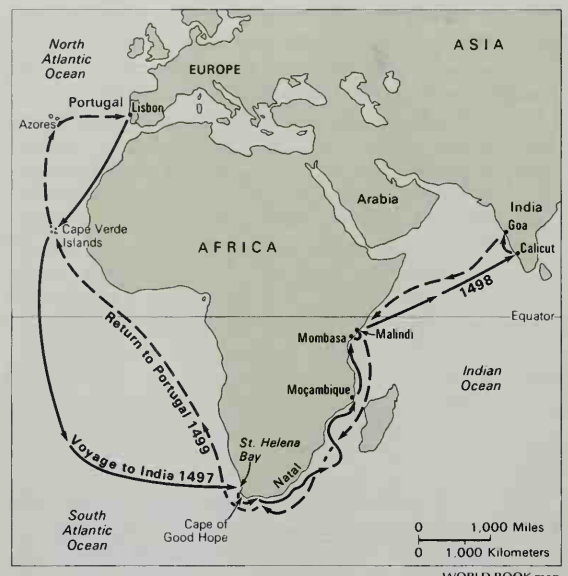
See also Bulb; Jonquil; Narcissus.

Da Gama, Vasco, *duh GAM uh, VAS koh* (1469?-1524), was a Portuguese sea captain and explorer. He commanded the first fleet to reach India from Europe. Da Gama sailed around the Cape of Good Hope to India in the late 1490's. His voyage opened the first all-water trade route between Europe and Asia.

Detail of an engraving by Broegg, Lisbon Geographical Society

Vasco da Gama

Early life. Da Gama was born in Sines, Portugal. He



WORLD BOOK map

Vasco da Gama sailed from Portugal to India in 1497 and 1498. His historic voyage, which is shown on this map, opened a new trade route between Europe and Asia.

probably attended school in the town of Évora. As a young man, Vasco learned astronomy and navigation. Da Gama became a naval officer in 1492 and commanded ships along the coast of Portugal.

Another Portuguese sea captain, Bartolomeu Dias, had discovered a route around the southern tip of Africa in 1488. He had sailed around the Cape of Good Hope. In 1497, King Manuel I of Portugal asked da Gama to find a sea route to India by sailing around Africa. The king wanted da Gama to establish trade with India. Da Gama's father had been chosen to lead the expedition, but he died before the plans were completed.

Voyage to India. Da Gama commanded four ships, including the *Berrio*, the *Saint Gabriel*, and the *Saint Raphael*. He had a total crew of about 170 men. His navigational equipment included compasses, an instrument called an *astrolabe*, and astronomical charts.

Da Gama sailed from Lisbon, Portugal, on July 8, 1497. He rounded the Cape of Good Hope on November 22, headed north, and stopped at trading centers that are now Moçambique, Mozambique; and Mombasa and Malindi, Kenya. Arab traders in Moçambique and Mombasa hated the Portuguese and tried to seize their ships. The people at Malindi were friendlier and arranged for a guide to lead the fleet to India.

On May 20, 1498, da Gama reached Kozhikode (also known as Calicut), India. But the Indian ruler felt insulted because he thought the gifts da Gama had brought him were of little value. In addition, Muslim merchants controlled trade in Kozhikode and resented European interference in their business. They continually threatened the Portuguese and would not trade with them. In August 1498, da Gama sailed for home with only samples of Indian goods. Many of the sailors died of disease during the voyage, and only 55 survived. Da Gama arrived in Lisbon in September 1499. King Manuel rewarded him and gave him the title of Admiral of the Sea of India.

Later life. The king sent another fleet to India in 1500 to break the Muslims' control of trade in that country. The Portuguese succeeded this time, and da Gama made a second voyage to India in 1502 to establish and expand trade there. He sailed from Lisbon with a fleet of 15 ships. Da Gama killed many innocent Indians and Muslims in revenge for violence against Portuguese sailors. Portugal soon became one of the most important trading and naval powers in the Indian Ocean.

After returning to Portugal in 1503, da Gama retired from the sea. In 1519, he was made Count of Vidigueira, which entitled him to collect taxes and rents in two Portuguese villages. In 1524, King John III named him viceroy of India. Da Gama sailed to India, where he died that same year. John Parker

See also **Exploration** (The voyage around Africa).

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Dagger is a small, handheld weapon with a short, pointed blade. Daggers are chiefly used for self-defense and sudden attack, but some have served purely ceremonial or decorative purposes. Daggers typically measure from 6 to 20 inches (15 to 51 centimeters) in length.

WORLD BOOK photo by Ralph Brunke

A dagger is a short-bladed weapon. This dagger was used by British commandos during World War II (1939-1945).

Both edges of the blade are sharpened. Daggers have been used since prehistoric times. Most daggers have had metal blades, but some have been made of stone, bone, wood, and plastic. The earliest form of bayonet was a dagger with a tapered handle that would fit into the muzzle of a musket. Walter J. Karcheski, Jr.

See also **Bayonet; Bowie knife.**

Daguerre, *dah GAIR,* **Louis Jacques Mandé,** *lwee zhahk mahn DAY* (1787-1851), a French stage designer and painter, introduced the first popular form of photography. His pictures were called *daguerreotypes.*

Daguerre was born on Nov. 18, 1787, in Cormeilles-en-Parisis, near Paris. He became a talented theater artist and operated a scenery theater called the Diorama in Paris. There he displayed huge painted scenes from nature, using lighting to create the illusion of changing views. A desire to improve these scenes led him to work with J. N. Niépce, a French scientist who had invented the first photographic technique. Experimenting with this technique, Daguerre discovered the daguerreotype process in 1837. The permanent mirrorlike images produced through the process brought him worldwide fame. Reese V. Jenkins

See also **Photography** (History).

International Museum of Photography at George Eastman House

A daguerreotype was an image on silver-plated copper.

Daguerreotype, *duh GEHR uh typ,* was the first practical, popular method of photography. It was named for Louis J. M. Daguerre, a French stage designer and painter who perfected the process in 1837. The word *daguerreotype* also refers to photographs produced by this process.

Daguerre's process involved treating a thin sheet of silver-plated copper with fumes from crystals of iodine to make the silver plating sensitive to light. The sheet was then placed inside a camera and exposed to light through the camera lens for 5 to 40 minutes. After the sheet was removed from the camera, it was developed by vapors from heated mercury. The mercury combined with the silver at the points where it had been affected by light, and formed a highly detailed image. The image was then *fixed* (made permanent) by treating the sheet with sodium thiosulfate.

Daguerre first published a description of his process in 1839. The process was soon improved by other inventors. By 1841, for example, the exposure time for the photographs had been reduced to less than a minute.

Daguerreotype portraits were very popular during the 1840's and 1850's, especially in the United States. The daguerreotype was eventually replaced by other processes. People now collect daguerreotypes of particular beauty or unusual subject matter. Grant B. Romer

See also **Daguerre, Louis J. M.; Photography** (History).

Dahl, Roald (1916-1990), was a famous British writer best known as an author of children's books. His honesty about difficult subjects, such as death, and his focus on many unflattering and obnoxious characters make his work particularly fascinating for children. His most famous book, *Charlie and the Chocolate Factory* (1964), is the story of a poor boy and four disagreeable children who tour an unusual candy factory. Dahl adapted this novel for the motion picture *Willy Wonka and the Chocolate Factory* (1971). His other books for children include *James and the Giant Peach* (1961), *Fantastic Mr. Fox* (1970), *The BFG* (1982), and *Matilda* (1988).

Dahl also wrote for adults. He became known for writing eerie and sophisticated short stories, many of which are collected in *Someone Like You* (1953), *Kiss, Kiss* (1959), and *Switch Bitch* (1974). The 1979 TV series "Tales of the Unexpected" dramatized 22 of Dahl's short stories.

Dahl was born near Cardiff, Wales. His father died when Dahl was 4 years old. Several of Dahl's books deal with the loss of parents. He wrote two autobiographies, *Boy* (1984) and *Going Solo* (1986). Michael Seidel

Dahlia, *DAL yuh,* is the name of a popular group of flowers cultivated from the original dahlia of Mexico. Some dahlias are ball-shaped; others have long, flat petals. *Cactus dahlias* have double blossoms with long, twisted petals. Dahlias are now grown throughout the United States, in southern Canada, and in Europe. They are named for the Swedish botanist Anders Dahl.

Dahlias grow from *tuberous,* or thick, fleshy roots that look somewhat like bulbs. They should be planted in rich, well-drained soil, and in full sun after all danger of frost has passed. After the first frost, the roots should be dug up and stored for the winter in a cool, dry place. Storing the root clump with soil attached will stop shriveling. At planting time, the roots should be separated and planted about 6 inches (15 centimeters) deep. Dahlias flower in the late summer. W. Dennis Clark

See also **Flower** (picture: Garden perennials [Bulbs]).

Scientific classification. Dahlias belong to the composite family, Compositae. The scientific name for garden dahlias is *Dahlia pinnata.*

Dahomey. See **Benin** (country).

Daimler, *DYM luhr,* **Gottlieb,** *GAHT leeb* (1834-1900), a German engineer, developed an internal-combustion engine light enough to power an automobile. He and another German engineer, Wilhelm Maybach, produced a motorized bicycle in 1885 and a motorized carriage in 1886. Daimler founded the Daimler Motor Company in 1890. The company produced the first Mercedes car in 1901. The Daimler and Benz companies merged to make the Mercedes-Benz car in 1926. In 1998, Daimler-Benz merged with the U.S.-owned Chrysler Corporation to form DaimlerChrysler AG. William L. Bailey

See also **Automobile** (The first cars); **Benz, Karl; Maybach, Wilhelm; Motorcycle** (picture).

DaimlerChrysler AG, *DYM luhr KRYS luhr,* is one of the largest manufacturers of automobiles in the world. The company was created in 1998 when the German automaker Daimler-Benz AG merged with the Chrysler Corporation, a United States company. *AG* is the abbreviation for a German word meaning *corporation.* DaimlerChrysler manufactures Chrysler, Dodge, Jeep, Mercedes-Benz, Plymouth, and Smart vehicles. It also produces aerospace equipment, buses, helicopters, industrial and marine engines, railroad equipment, and trucks. In addition, the company operates a division that offers financial and information technology services.

Walter P. Chrysler organized Chrysler Corporation in 1925. Chrysler Corporation introduced several engineering features to the automobile industry. These features included the alternator, full-time power steering, torsion bar suspension, and the curved, one-piece windshield. The company manufactured the modified Redstone

missile that helped launch the first U.S. artificial satellite.

Two German manufacturers, Daimler Motor Company and Benz & Co., merged to form Daimler-Benz in 1926. Daimler-Benz was known for the superior engineering of its luxury automobiles and heavy-duty trucks. It was the first manufacturer to adapt antilock brakes and diesel engines to passenger cars. Daimler-Benz also played a major role in the development of air bags.

DaimlerChrysler has headquarters in Stuttgart, Germany, and Auburn Hills, Michigan, in the United States. It operates manufacturing facilities in about 35 countries. Critically reviewed by DaimlerChrysler AG

See also **Manufacturing** (table: 25 leading manufacturers).

Dairying is the branch of agriculture concerned with the production of milk, butter, evaporated milk, ice cream, cheese, and dried milk products. It includes the care and feeding of the cattle that give the milk. Dairy farming is a leading agricultural activity in the United States. The country's milk producers get about $20 billion a year from the sale of their products. Dairying accounts for most of the income of about 170,000 U.S. farms.

There are about 10 million milk cows on farms in the United States. They produce about 22 billion gallons (84 billion liters) of milk each year. The average yearly milk production per cow is 2,000 gallons (7,570 liters). The largest amount of this milk—37 percent—is used for fluid milk and cream. Thirty-two percent of the milk is used for cheese, 20 percent for butter, 9 percent for ice cream, and 2 percent for dry, condensed, or evaporated milk.

Dairy farms

There is dairy farming in every state. However, the industry is concentrated in a group of states in the East and Midwest, from New York to Minnesota. Dairy farming is also important on the Pacific Coast, particularly in California. The average size of U.S. dairy herds is 39 cows. Large commercial dairy farms may have more than 1,000 cows.

Wisconsin leads the states in milk production, producing about 3 billion gallons (11 billion liters) per year. The other leading milk-producing states are California, New York, Minnesota, and Pennsylvania, in that order.

Robert Barclay, Grant Heilman

In a loose-housing system, *shown here,* individual freestalls allow the cows to enter and leave at any time to eat, drink, and exercise. Large dairy farms may have more than 1,000 cows.

Quebec ranks as Canada's leading milk-producing province. Its cows produce about 700 million gallons (2.6 billion liters) of milk a year.

Dairy cattle. The six most important breeds of dairy cattle in the United States are the Holstein-Friesian, Jersey, Guernsey, Ayrshire, Brown Swiss, and Milking Shorthorn. They vary in size and color. Holsteins are black and white. Jerseys are fawn to brown, with or without white markings. Guernseys are pale fawn or fawn and white. Ayrshires are deep red, brown, or a combination of these colors with white. Brown Swiss are solid brown, and Milking Shorthorns are red, white, or *roan* (a mixture of red and white). The Brown Swiss is generally the largest breed, weighing about 1,500 pounds (680 kilograms). The Jersey, at 1,000 pounds (450 kilograms), is the smallest. The breeds are also distinguished by the composition of their milk and the amount they produce.

The breed of cattle kept on a dairy farm depends upon the farmer's preference and the market for milk. More than 90 percent of all dairy cattle in the United States are Holstein. They are the most popular breed because they produce a high volume of milk. Jerseys are the next most popular because their milk is the richest. It has 5 percent *butterfat* (the natural fat in milk), and is the highest in protein. Jerseys are easier to handle and tolerate heat better than other breeds.

Dairy cattle whose ancestry can be traced to the original animals of a breed are called *purebred.* A *registered* animal is one whose ancestry has been recorded with a breed association. Most dairy cattle are not registered with a breed association. Such cattle are called *grade cows.* Most grade cows are the offspring of unregistered parents of the same breed. However, many grade cows are born of unregistered cows and registered purebred bulls.

Milking. Dairy farmers usually milk their cows at regular times, once each morning and once each evening at 12-hour intervals. Most dairy farmers milk their cows by machine. These machines attach to the cows' teats and pump the milk directly from the cow through a glass or steel pipeline into a separate milk house. This system keeps the milk clean. The milk also tastes better if it is not exposed to the air in the barn. The milk house has vats for washing equipment and a tank where the milk is cooled and stored until the farmer can ship it.

Most of the milk marketed as *Grade A* fluid milk comes from dairy farms that meet strict quality codes and standards. On some farms, workers step into a pan of disinfectant before entering the milking parlor. They carefully wash the cows' udders to remove impurities before milking. During the milking, the workers rinse the utensils periodically. After they are finished milking, they wash and sanitize all equipment. They also wash the milk house and milking parlor floors.

Housing. There are two main types of housing systems for dairy cattle: *confinement housing* and *loose housing.* In confinement housing, farmers keep their cows in individual stalls at all times, except for milking and brief exercise periods. Some confinement stalls have *stanchions,* metal pipes that go around the cow's neck to keep her in place in the stall. Dairy workers can open or close each stanchion separately. Other cows live in *tie stalls.* In a tie stall, cows are tied on two or

three feet of chain and have more room to move.

In the confinement system, the cows have separate *feed bunks* (troughs) and drinking cups. A *gutter* runs behind the stalls to collect the cattle's manure and urine. Many gutters are equipped with mechanical devices called *barn cleaners.* A barn cleaner is a chain with paddles that pull the manure into a manure spreader or holding area. The spreader is used to scatter manure onto the land to make the soil more fertile.

In the loose-housing system, cows are free to move around as they please. When it is warm, they may go out to the pasture between milkings. In cold weather, they may rest in a *loafing barn,* a large shed that is open on one side. Farms that do not have a loafing barn usually have individual *freestalls* that allow the cows to enter and leave at any time to eat, drink, or exercise.

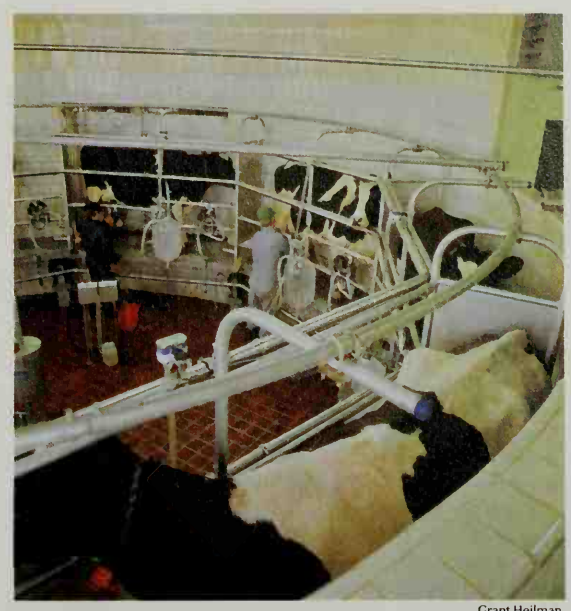
Modern dairy farmers keep their barns very clean. On many farms, workers wash the barns with a disinfectant to kill germs and prevent diseases from spreading through the herd. Barns should also have adequate ventilation to protect the cows' health and the flavor of the milk.

Feeding. A good dairy cow may weigh up to 1,700 pounds (770 kilograms) and produce 2,300 gallons (8,700 liters) or more of milk during a year. To do this, the cows eat large amounts of *concentrates* and *forages.* Concentrates are grains and by-product feeds. By-product feeds include corn gluten feed and meal, dried beet pulp, molasses, and wheat millfeeds. Forages consist of *pasture* (grasses, legumes, and other plants), hay, and *silage* (chopped-up stalks of corn and other crops). Farmers usually store hay in the barn loft or in a hay shed. Silage is stored in a silo, where it ferments. Most high-producing herds are fed in *dry lots,* rather than put out to pasture. Workers bring the feed to the lots, and the cows eat together from long feed bunks.

Cows that produce a large amount of milk need feed that provides energy, protein, and essential vitamins and minerals. Dairy farmers try to balance a cow's ration and provide all food nutrients in the proper amounts and proportions. For example, if farmers feed their cows a low-protein forage, such as corn silage, they increase the amount of protein in the concentrate mixture. Typical energy feeds include barley, corn, grain sorghums, oats, and wheat. Cottonseed and soybean meal are typical protein supplements. Some forages that supply both protein and energy are alfalfa, clover, corn silage, mixed hays, sorghum silage, and many varieties of pasture.

The economics of dairying. Dairy farming requires large financial investments. Dairy farmers in the Northern States invest an average of $804,000 for a farm with 52 cows. This amount includes the price of land, cattle, buildings, and equipment. Each cow must produce about 1,600 gallons (6,100 liters) of milk per year to cover all costs of production. Profits for dairy farmers are usually small. However, dairy farmers can make a good profit with high milk-yield per cow, efficient operation, and the use of labor-saving technology.

Improvements in dairy farming. Today's farmers have greatly increased milk production efficiency through improved methods of breeding, feeding, and managing dairy cattle. Although the average yearly production of milk per cow in the United States has risen to 2,000 gallons (7,570 liters), many good dairy herds average 2,400 gallons (9,100 liters) of milk per cow. In 1997, one Holstein cow named Muranda Oscar Lucinda produced 7,897 gallons (29,893 liters)—a world record.



Grant Heilman

The milking parlor of a dairy farm is a special room where the cows are milked by machines. The milk is then piped to a refrigerated tank.

Various organizations have contributed to the increased efficiency of dairy farming. Among these organizations are dairy herd improvement (DHI) associations, the United States Department of Agriculture, colleges of agriculture, and the Purebred Dairy Cattle Association. DHI associations are cooperative organizations of dairy farmers. Each association employs trained supervisors to keep monthly milk, protein, and butterfat production records on association herds. Supervisors advise members on how to feed and care for the cattle. They also help farmers decide which cows are not good producers and should be removed from the herd. Cows in DHI association herds produce an average of about 2,100 gallons (8,000 liters) of milk annually.

More than half of all dairy cows in the United States are now bred by *artificial insemination.* Dairy farmers artificially inseminate cows by placing *semen* (sperm-containing fluid) from a donor bull in the reproductive organs of their fertile cows. The average bull used by an artificial insemination organization can be mated to over 3,000 cows a year. This method enables farmers to increase their use of outstanding purebred bulls.

Dairy farming regulations

Many states and local governments have laws regulating the conditions under which dairy farmers can produce and sell milk. These laws are essential because of the many ways in which milk can become contaminated. All the containers that the milk passes through as it travels from the cow to the consumer must be clean, sterile, and dry. Some cattle diseases can infect human beings through impure milk. Tuberculosis spread in this way until farmers removed tubercular cows from their dairy

herds. Brucellosis is a disease that strikes some herds. Farmers control brucellosis by testing their cattle, vaccinating the calves, and eliminating animals.

Most laws regulating dairies require that the operator have a license. Dairy inspectors make sure that the farms meet sanitary regulations. Workers in dairies and milk plants undergo periodic physical examinations to make sure they are healthy. The milk is tested to be certain that its composition meets the legal standard and that it contains no impurities or disease-causing bacteria.

Most communities have regulations dealing with Grade A milk. These laws cover the health of cows and the sanitary conditions under which milk is produced and handled. About 85 percent of all milk sold is Grade A. With today's processing equipment and refrigerated tank trucks, dairy managers can ship milk long distances easily and safely.

Dairying around the world

Dairying is carried on in most countries of the world. Denmark, New Zealand, and Switzerland are famous for their dairy products. Before its breakup, the Soviet Union led the world in milk production. The United States ranked second, followed by Germany, France, and India.

People throughout the world use the milk of various animals. Goats are an important dairy animal in many countries. In the United States, however, goats provide only a small share of the milk supply. In France and Greece, sheep's milk is used in making certain cheeses. People in Arab lands drink camel's milk. Laplanders drink reindeer milk, and the people of Egypt and India use the milk of the water buffalo.

History of dairying

Norwegian Vikings may have brought the first cattle to the Americas in the early 1000's. Historians are certain that Christopher Columbus carried cattle on his second voyage to America in 1493. English colonists brought cows to the Jamestown settlement in the early 1600's. Later, they took cows with them to Plymouth and other New England settlements. Cattle raising spread quickly.

An important advance in dairying developed in colonial Massachusetts in the late 1600's. Before that time, cows gave milk only during the spring, summer, and fall, when they could feed in open pastures. Farm families used up what little milk the cows gave, and had very little to sell. Then, the colonists began feeding grain and hay to cattle during the winter. The cows gave milk all winter. This method of feeding cattle, called *stall-feeding,* made it possible to produce milk year-round.

When the pioneer families moved westward, much of their food consisted of butter, cheese, and milk. They found that cattle manure fertilized the soil. They kept more cattle, and sold the surplus milk.

The biggest development in the growth of dairying in the United States came after 1840, when the large cities began to expand. Before that time it had not been difficult to supply the cities with dairy products because farm and city were close together. After the cities grew, shipping milk to the consumer became a problem. However, after 1830, the number of railroads in the Eastern United States multiplied rapidly, and the first trainloads of milk arrived in New York City in 1841. In a few years, city dwellers all over the United States were drinking milk from farms as far as 50 miles (80 kilometers) away.

For many years, farmers manufactured dairy products on the farm. In 1850, farmers in the United States churned almost 315 million pounds (143 million kilograms) of butter. But as city markets increased, it became necessary to process milk on a larger scale. The first *creamery* (butter factory) was set up in New York about 1856. Soon, there were many creameries scattered throughout the Eastern and Midwestern states. The manufacture of milk products has become highly industrialized. Today, there are creameries throughout the country. Michael F. Hutjens

Related articles in *World Book* include:

Agriculture	Cheese	Milking machine
Barn	Cooperative	Pasteurization
Butter	Hay	Silo
Cattle	Milk	

Daisy is a name given to many flowers. The name comes from the Old English words for *day's eye.* It refers to the fact that daisy blossoms, like an eye, close at night and open at dawn. Daisy blossoms actually consist of many small flowers of two types—tiny *disk flowers* in the center and petallike *ray flowers* around the edge.

WORLD BOOK illustration by Robert Hynes

The oxeye daisy is a common plant that has a center of tiny yellow disk flowers surrounded by white petallike ray flowers.

Several species known as daisies are in the *genus,* or scientific grouping, *Chrysanthemum.* These species usually have yellow disk flowers and white or yellow rays. The *oxeye,* or *white, daisy* is the most common wild daisy in North America. It originally came from Europe and western Asia. The oxeye daisy grows in fields and on roadsides. It grows up to 3 feet (1 meter) tall, with blossoms up to 2 inches (5 centimeters) across.

The *Shasta daisy* is a popular cultivated member of the chrysanthemum group. It was developed by the famous American horticulturist Luther Burbank. It is a large, sturdy plant that grows over 3 feet (1 meter) tall, with blossoms that measure as much as 4 inches (10 centimeters) across.

English daisies belong to the genus *Bellis* and are called true daisies. The leaves are bunched at the bot-

tom of the stem, leaving the stalk naked. The blossom consists of yellow disk flowers and white, pink, red, or purplish rays. English daisies rarely grow over 6 inches (15 centimeters) tall. The blossoms measure nearly 2 inches (5 centimeters) across.

Scientific classification. Daisies belong to the composite family, Compositae. The scientific name for the oxeye daisy is *Chrysanthemum leucanthemum.* The Shasta daisy is *C. X superbum.* The English daisy is *Bellis perennis.* Margaret R. Bolick

See also **Black-eyed Susan; Composite family.**

Dakar, *dah KAHR* (pop. 1,447,642), is the capital and largest city of Senegal and the westernmost city on the mainland of Africa. Dakar is Senegal's major seaport and an important industrial and transportation center. For location, see **Senegal** (map).

Dakar's port is a center of trade. The city's economic activities include food processing, printing, tourism, and the manufacture of cement, cigarettes, shoes, soap, and textiles. An international airport and the University of Dakar are in the city. Dakar has modern buildings and buildings of French colonial architecture. It also has *shantytowns* (areas of shacks and huts).

Dakar began to grow in 1857, when a French fort was built on the site of a settlement there. It later became the capital of French West Africa. Senegal became an independent nation in 1960. Many people have since moved to Dakar from rural areas, and the city faces housing and unemployment problems. Lucy E. Creevey

Dakota. See **North Dakota; South Dakota.**

Dakota Indians. See **Sioux Indians.**

Daladier, *dah lah DYAY,* **Édouard,** *ay DWAHR* (1884-1970), as premier of France, reluctantly signed the Munich Agreement in 1938. This agreement between Britain, France, Italy, and Germany forced Czechoslovakia to give some territory to Germany. In return, Germany agreed not to make additional territorial demands (see **Munich Agreement**). Daladier approved the agreement chiefly to maintain an alliance with Britain. But Germany broke the agreement by seizing the rest of Czechoslovakia in March 1939. World War II began six months later when Germany invaded Poland. After France fell to Germany in 1940, Daladier was imprisoned by the French government that was headquartered at Vichy in southern France. Édouard Daladier was born in Carpentras, France. John F. Sweets

Dalai Lama, *dah LY LAH muh,* is the leader of the Yellow Hat, the chief Buddhist sect of Tibet. The title means "teacher whose wisdom is great as the ocean." The Dalai Lama served as the political and religious ruler of Tibet from the reign of the fifth Dalai Lama in the 1600's to 1959. In that year, the Dalai Lama went into exile in response to China's control of Tibet.

Followers of the Yellow Hat sect believe there is only one Dalai Lama, who has been reborn over the centuries. After a Dalai Lama dies, monks conduct a search to find the boy in which he is next reborn. The successor is expected to show signs of continuity with the one who died, such as being born about the same time as the death. Monks carefully train the new Dalai Lama to prepare him for his high position.

In 1578, a Mongolian emperor first gave the title of Dalai Lama to the third leader of the Yellow Hat sect. The current Dalai Lama, the 14th, lives in India as the head of an exiled Tibetan community. He is a monk, scholar, and statesman who received the 1989 Nobel Peace Prize for his nonviolent struggle to end China's rule of Tibet.

Gene R. Thursby

See also **Lamaism; Tibet** (Religion and culture; History and government).

Daley, Richard Joseph (1902-1976), a Democrat, was mayor of Chicago from 1955 until his death in 1976. During that time, he was one of the most powerful political leaders in the United States. He was elected to his first term as mayor in 1955, and was reelected in 1959, 1963, 1967, 1971, and 1975.

Daley headed the Cook County Democratic organization, perhaps the strongest political machine in the United States. He became an adviser to President John F. Kennedy and to President Lyndon B. Johnson. Under Daley's leadership, Chicago reorganized its police department, encouraged the construction of many major downtown buildings, and pushed an urban renewal and rebuilding program that removed many slums.

In the early 1970's, Daley's administration was rocked by several scandals and trials involving corruption. None involved Daley. But many high officials were found guilty. Over 50 police officers were convicted of taking bribes from tavern owners.

Daley suffered a political setback in 1972 when the city's regular Democratic delegates were barred from

Nik Wheeler

Dakar, the capital and largest city of Senegal, is an important seaport. Modern buildings line the port.

the party's national convention in a fight over delegate selection procedures. But he won renewed national prestige with a decisive reelection victory in 1975.

Daley was born on May 15, 1902, in Chicago. He received undergraduate and law degrees from DePaul University. He was elected to the Illinois House of Representatives in 1936 and later served in the Illinois Senate and as state revenue director. His son Richard M. Daley also became mayor of Chicago. He was first elected to the office in 1989. Another son, William M. Daley, served as U.S. secretary of commerce under President Bill Clinton from 1997 to 2000. Charles E. Nicodemus, Jr.

See also **Chicago** (Government).

Dali, *DAH lee,* **Salvador** (1904-1989), was a famous surrealist painter. His unusual pictures made him one of the most publicized figures in modern art.

Dali called his surrealist paintings "hand-painted dream photographs." The pictures show strange, often nightmarish combinations of precisely detailed figures and objects. Many of his paintings have violent or sexual associations or both. The barren landscapes and fantastic rock formations of the Spanish region of Catalonia, where Dali was born, appear in a number of his works. Dali's *Persistence of Memory* illustrates his realistic technique and his use of complicated, puzzling symbols. This painting appears in the **Painting** article. Dali also created many etchings and lithographs. He designed many of these prints to illustrate books.

United Press Int.

Salvador Dali

Salvador Felipe Jacinto Dali was born on March 11, 1904, in Figueras, Spain. He was also a sculptor and jewelry designer. He worked with Spanish film director Luis Buñuel on two surrealist movies—*An Andalusian Dog* (1929) and *The Golden Age* (1930). Willard E. Misfeldt

See also **Surrealism.**

Additional resources

Dali, Salvador. *The Secret Life of Salvador Dali.* 1942. Reprint. Dover, 1993.

Etherington-Smith, Meredith. *The Persistence of Memory: A Biography of Dali.* 1993. Reprint. Da Capo, 1995.

Dallapiccola, *DAH lah PEE koh luh,* **Luigi,** *loo EE jee* (1904-1975), was an Italian composer. He became best known as a pioneer of *dodecaphony* in Italy. Dodecaphonic music is a 12-tone technique. Dallapiccola's musical style is characterized by delicate *counterpoint* (multiple melodies), lyrical lines and textures, and subtle tone colors. His work was influenced by the modern Austrian composers Alban Berg and Anton Webern as well as by Italian Renaissance vocal music.

Dallapiccola's two-act opera *Ulisse* (1968) brought him world fame. His compositions for solo voice and instrumental ensemble of the 1950's and 1960's rank among his finest works. Dallapiccola also composed two one-act operas, a ballet, the oratorio *Job,* and many choral and solo vocal works. He was born on Feb. 3, 1904, in Pazin (now in Slovenia), near Trieste. Vincent McDermott

Collection of Julien Levy, Bridgewater, Connecticut. WORLD BOOK photo by Robert Crandall

Dali's *Accommodations of Desire* was completed about 1929. This oil and collage painting shows the mysterious combination of realistic figures and objects typical of the artist's style.

Raymond Roberts, Dallas Convention and Visitors Bureau

Downtown Dallas lies on the Trinity River. The city's landmarks include the 72-story Bank of America Plaza—the tallest building in Dallas—and the domed Reunion Tower, *left.*

Dallas

Dallas is the second largest city in Texas and is located in the heart of one of the fastest growing metropolitan areas in the United States. Houston is the only Texas city with more people. Nicknamed "Big D," Dallas ranks as one of the nation's major financial, insurance, manufacturing, and transportation centers. The city serves as the seat of Dallas County.

Dallas is located on the rolling prairies of north-central Texas, about 30 miles (50 kilometers) east of Fort Worth. John Neely Bryan, a lawyer and trader, founded Dallas in 1841 on the banks of the Trinity River. The city's rapid growth began when railroad companies constructed tracks through the city in the 1870's. Today, the city's financial success still depends on its transportation links. The Dallas/Fort Worth International Airport, which serves the two cities, is one of the busiest airports in the world. Convenient air service has helped the Dallas area become the national headquarters for many important United States companies.

The city

Layout of Dallas. The Trinity River divides the city of Dallas. North and east of the river is the downtown business district. Oak Cliff, a residential area, lies south and west of the Trinity.

Outside the downtown area are sections of the city that are known as East Dallas, West Dallas, North Dallas, and South Dallas. Dallas covers 378 square miles (979 square kilometers). Most of the city is located in Dallas County, but small sections of Dallas extend into Denton and Collin counties. Three independent communities, each having its own government—Cockrell Hill, Highland Park, and University Park—lie within the Dallas city limits.

Landmarks. The tallest building in downtown Dallas is the 72-story Bank of America Plaza, which opened in 1985. The West End Historic District, at the west edge of downtown, includes several historic sites. One is the Old Dallas County Courthouse, known as "Old Red," which was built of red sandstone in 1892. Also in the historic district is a restored log cabin that may include parts of a home built by the founder of Dallas, John Neely Bryan. Besides the historic sites, the district also features shops and restaurants in restored warehouses. These warehouses were once owned by early Dallas merchants.

In the West End Historic District are Dealey Plaza and the Texas School Book Depository (now the Dallas County Administration Building). In 1963, President John F. Kennedy was killed in Dealey Plaza by a bullet fired from the sixth floor of the building. The depository's sixth floor is now a museum depicting the events of Kennedy's life and death. Near Dealey Plaza is a memorial honoring the late President.

Shoppers flock to the original Neiman-Marcus store in downtown Dallas. The Dallas City Hall, designed by American architect I. M. Pei, stands at the south end of downtown. A large sculpture, *The Dallas Piece* by English sculptor Henry Moore, decorates the City Hall plaza. Next to the City Hall is the Dallas Convention Center,

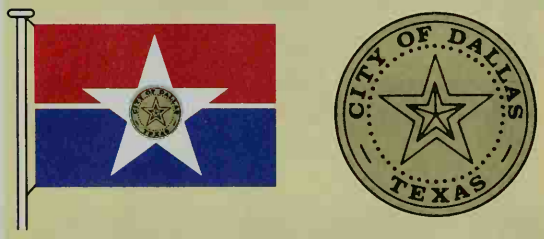
Facts in brief

Population: *City*—1,188,580. *Metropolitan area*—3,519,176. *Consolidated metropolitan area*—5,221,801.
Area: *City*—378 mi² (979 km²). *Metropolitan area*—6,491 mi² (16,812 km²). *Consolidated metropolitan area*—9,470 mi² (24,527 km²).
Altitude: 512 ft (156 m) above sea level.
Climate: *Average temperature*—January, 43 °F (6 °C); July, 85 °F (30 °C). *Average annual rainfall*—33.7 in (85.6 cm). For the monthly weather in Dallas, see **Texas** (Climate).
Government: Council-manager. *Terms*—Two years for City Council members; four years for the mayor. City manager is appointed by the council.
Founded: 1841. Incorporated as a town, 1856; as a city, 1871.

Largest communities in the Dallas area

Name	Population	Name	Population
Dallas	1,188,580	Mesquite	124,523
Plano	222,030	Carrollton	109,576
Garland	215,768	Richardson	91,802
Irving	191,615	Denton	80,537
Grand Prairie	127,427	Lewisville	77,737

Source: 2000 census.



Symbols of Dallas. The red, white, and blue in the flag of Dallas represent the United States and Texas, which use these colors in their flags. The star is the chief symbol of Texas, the Lone Star State. The flag, which was adopted in 1967, also bears the city seal.

with about 800,000 square feet (74,000 square meters) of exhibition space. A bronze sculpture display of a cattle drive near the center's entrance is a popular attraction.

The beautiful Majestic Theatre serves as home to various arts organizations. Just west of the downtown business district is Reunion Arena, used for sporting events. Near the arena is the 50-story Reunion Tower. The tower's observation deck offers spectacular 360-degree views of the city and suburbs.

On the north side of downtown is the 60-acre (24-hectare) Dallas Arts District, site of the Dallas Museum of Art and the Morton H. Meyerson Symphony Center. The Dallas Market Center, a major wholesale buying center, lies along Stemmons Freeway northwest of downtown. It also offers major exhibition space for trade shows. The Dallas Zoo in Oak Cliff features a monorail that gives visitors good views of its African animals collection.

American Airlines Center, a sports arena, is just north of the downtown area. The Biblical Arts Center lies about 6 miles (10 kilometers) north of downtown. It has an international collection of religious art. The Dallas Farmer's Market on the southeast side of downtown offers fresh produce, flowers, and other goods from throughout Texas.

The Dallas metropolitan area includes Collin, Dallas, Denton, Ellis, Henderson, Hunt, Kaufman, and Rockwall counties. It covers 6,491 square miles (16,812 square kilometers). From 1990 until 2000, the area's population increased 29 percent. Among the largest cities in the Dallas area are Carrollton, Garland, Grand Prairie, Irving, Mesquite, Plano, and Richardson. These suburban cities have many landmarks. The Heritage Farmstead in Plano is a museum of farm life from 1890 to the 1930's. Williams Square in Irving features a popular bronze sculpture of nine mustangs galloping across a stream.

People

Ethnic groups. Approximately 51 percent of Dallasites are white, and about 26 percent are African American. About 36 percent of the city's people are Hispanic, who may be white, black, or of mixed ancestry. The city's population also includes many people of Arab, Native American, and Southeast Asian ancestry. Although Dallas no longer is segregated, the greatest number of African Americans live in South Dallas. There are large Hispanic neighborhoods in Oak Cliff and just north of downtown. Many refugees from Southeast Asia have settled in older residential neighborhoods east of downtown. Most people who live in Dallas suburbs are white.

Housing. Housing in Dallas is relatively new compared to other large cities. More than 40 percent of the housing units in Dallas have been built since 1970.

There are many different types of housing in the city and suburbs. Many of the biggest homes are in North Dallas neighborhoods such as Preston Hollow, in the "island cities" of Highland Park and University Park, and in such higher-income suburbs as Addison, Irving, and Plano. The Swiss Avenue Historic District in East Dallas features many mansions built by the city's business leaders in the late 1800's and early 1900's. Homes along Swiss Avenue began to be restored in the early 1970's.

Some of the lowest-income housing is in West Dallas, an area the city did not annex until the early 1950's. Before annexation, there were no construction guidelines in West Dallas to ensure that new structures were sturdily built and met other requirements. Today, the area has many run-down homes.

Social problems. Like other large cities, Dallas has experienced crime, unemployment, and urban decay. However, the city has tried to reduce these problems by promoting job creation, downtown and inner-city construction, and other activities.

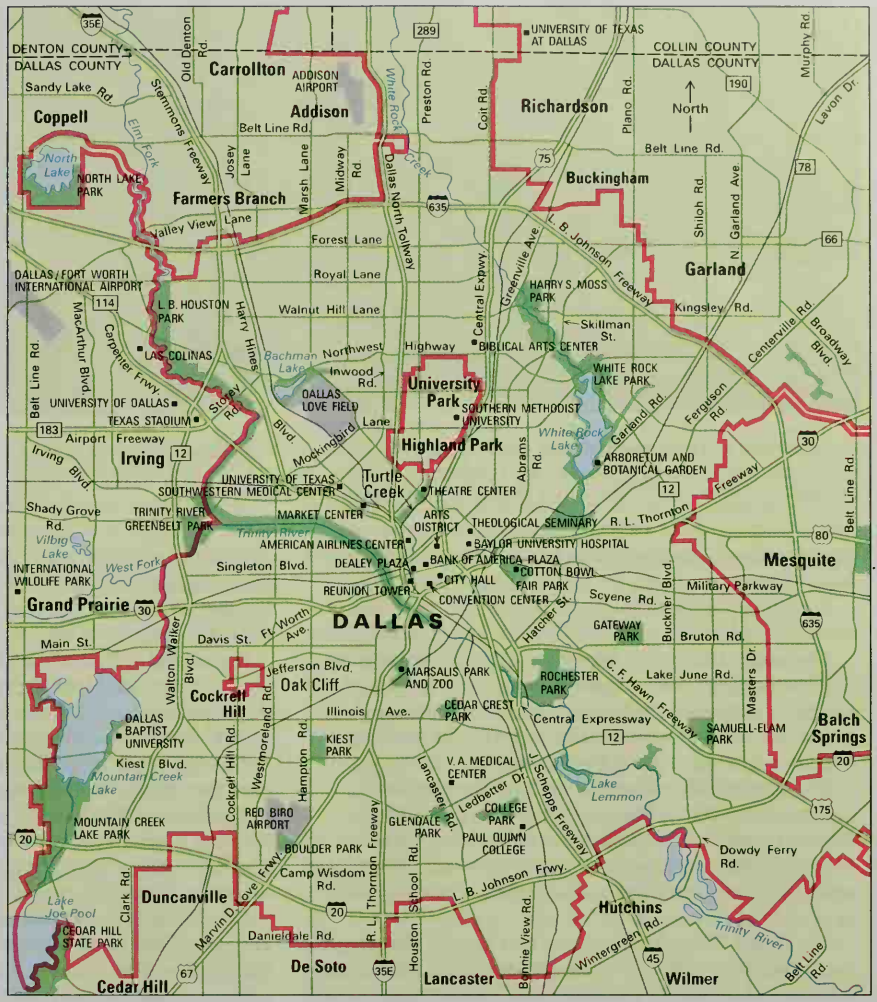
Dallas has also experienced some racial problems. For example, minority groups have lacked political and job opportunities in the city. But community organizations, such as the Dallas Together Forum, work to improve the prospects of minorities.

Another problem is air pollution, created primarily by vehicle traffic. The city government encourages motorists to carpool or use buses to reduce air pollution.

Education. The Dallas Independent School District is one of the largest U.S. public school systems. It includes about 200 elementary and high schools with an enrollment of about 140,000 students. About 110 private schools provide education for approximately 27,000 stu-

City of Dallas

City boundary
County boundary
Expressway
Other street
Railroad
Point of interest
Park



WORLD BOOK maps

Dallas Convention and Visitors Bureau

The Dallas Black Dance Theatre is one of many performing arts groups in Dallas. Such groups make Dallas a cultural center.

dents in Dallas and the surrounding area. Greenhill School, Hockaday School, the Jesuit Preparatory School, and St. Mark's School of Texas are among the city's best-known private schools. In addition, the Dallas suburbs have many excellent public schools.

Southern Methodist University, in University Park, is the oldest university in the Dallas area. Founded in 1911, it has an enrollment of 9,000 students and offers strong programs in liberal arts and business administration. The University of Texas Southwestern Medical Center at Dallas has become a major facility for scientific research. Paul Quinn College, in South Dallas, is an African American college associated with the African Methodist Episcopal Church. Texas A&M University Baylor College of Dentistry, Dallas Baptist University, and the Dallas Theological Seminary are also in the city. Other schools of higher education in the Dallas area include the University of Texas at Dallas, located in Richardson, and the University of Dallas, a Roman Catholic-affiliated school in Irving. In addition, the Dallas County Community Col-

A monument to Texas cattle drives stands in the heart of Dallas. Called *The Drive*, it features dozens of bronze sculptures of cattle and cowboys. It stands in Pioneer Plaza, next to the Dallas Convention Center. The picture above shows part of the huge monument.

lege District consists of seven two-year community colleges in the Dallas area.

Cultural life

The arts. Dallas is an important cultural center of the Southwest. The Dallas Opera performs at the Music Hall at Fair Park, and the Dallas Symphony Orchestra plays at the Morton H. Meyerson Symphony Center. Touring Broadway productions appear in the Majestic Theatre. The Majestic is also home to such performing arts groups as the Dallas Black Dance Theatre, the Dallas Classic Guitar Society, Ballet Dallas, and the Anita M. Martinez Ballet Folklorico. Summer musicals at Fair Park and the Shakespeare Festival of Dallas attract thousands of people each year.

The Dallas Theatre Center has two facilities for stage performances—the Arts District Theater downtown and the Kalita Humphreys Theatre in the Turtle Creek area of North Dallas. American architect Frank Lloyd Wright designed the Kalita Humphreys Theatre. Smaller theater companies include Teatro Dallas, Pegasus Theatre, Undermain Theatre, and Theatre Three.

Museums and libraries. The Dallas Museum of Art is in downtown Dallas. It is noted for its collections of art from Africa, the Americas, and Europe.

Fair Park, which is 2 miles (3.2 kilometers) east of downtown, contains buildings in the streamlined art deco style of architecture. Many of the buildings were constructed for the 1936 Texas Centennial Exposition, which celebrated 100 years of Texas independence.

Fair Park features several museums and cultural institutions. The Science Place there includes robotic dinosaurs and a planetarium. The Dallas Museum of Natural History at Fair Park exhibits dinosaur skeletons and rare fossils that were found in Texas. The park's Age of Steam Railroad Museum offers tours of antique locomotives, freight cars, and passenger cars. The Texas Hall of State is run by the Dallas Historical Society. It displays historical documents as well as photos, costumes, and other items from everyday life in early Texas. Each year in late September and early October, about 3 million people attend the State Fair of Texas in the park's fairgrounds.

The Dallas Public Library System includes the J. Erik Jonsson Central Library downtown and many branch libraries throughout the city. The Dallas suburbs also have excellent libraries.

Recreation. Dallas has 335 public parks that cover 46,581 acres (18,851 hectares). More than two-thirds of the city's parkland is in the Trinity River Greenbelt, which is preserved as open space with few roads or buildings. White Rock Lake in East Dallas is a popular park for sailing, fishing, jogging, and biking. The Dallas Arboretum and Botanical Garden at White Rock Lake displays thousands of flowers and trees in an attractive lakeside setting. Six Flags over Texas, in Arlington, is a theme park that offers amusement rides and shows.

The Dallas area has teams in all four major professional sports. The Dallas Cowboys play in the National Football League. The Texas Rangers of the American League play major league baseball. The Dallas Mavericks play in the National Basketball Association. The Dallas Stars play in the National Hockey League. Every New Year's Day,

Dallas Convention and Visitors Bureau

Electronics is one of the most important industries in the Dallas area. The area is home to several major producers of electronic equipment, including Texas Instruments, *shown here.*

the Cotton Bowl football game, in Fair Park's Cotton Bowl stadium, features two of the nation's outstanding college teams.

Economy

The Dallas area's economy consists of a wide variety of industries. During the 1980's, the area shifted from a manufacturing to a service-based economy.

Service industries. Dallas depends heavily on convention business and tourism. Millions of people attend conventions in Dallas each year, adding billions of dollars to the economy. The city's many banks make Dallas an important financial center for the Southwestern United States. Dallas is the home of a great number of insurance companies. Dallas is also an important cotton market because Texas ranks as the nation's top cotton-producing state.

Manufacturing. The Dallas area is a major center for the manufacture of clothing, electronics and *telecommunications* (electronic communications) equipment, food products, machinery, and printed material. About 1,900 industrial facilities provide jobs for the city's labor force. The Dallas area also serves as the headquarters of many oil firms. Among the largest oil companies in the area are Exxon Mobil Corporation in Irving, and the Dallas-based companies Fina Incorporated, Maxus Energy Corporation, and Oryx Energy Company.

Transportation and communication. Dallas/Fort Worth International Airport and Dallas Love Field have helped make Dallas a vital transportation hub of the Southwest. Railroad companies provide freight and passenger service to the city. The city has one daily newspaper, *The Dallas Morning News.*

Government

Dallas has a council-manager form of government. The City Council consists of a mayor and 14 council members. Dallas voters elect the mayor to a four-year term and the council members to two-year terms.

The council sets general policies for governing. It hires the city manager, who is the administrative head of the government. The manager carries out the policies of the council, prepares the annual city budget, and appoints department heads. The city's chief sources of revenue include property taxes, sales taxes, and charges for services. Revenue bonds and federal grants also provide funds. The Dallas suburbs have their own independent local governments.

History

Early settlement. In 1841, John Neely Bryan, a lawyer from Tennessee, dug a rough shelter in a hillside along the Trinity River, at the site of what is now Dallas. Bryan laid claim to 640 acres (260 hectares) of land, and later built a log cabin home on the property. Dallas was made the temporary seat of Dallas County in 1846, while the town was still an obscure frontier village. It became the permanent seat in 1850. Bryan named the town Dallas, possibly after George Mifflin Dallas, vice president of the United States from 1845 to 1849.

Bryan sold and gave away lots to new settlers, and he laid out the streets of the town. Dallas began to grow. In 1855, a group of European scientists, writers, artists, and musicians settled near Dallas. The Europeans, most of whom came from France, Belgium, and Switzerland, formed a cooperative community known as La Reunion. They farmed a tract of land that they owned in common. But La Reunion failed, and many of its residents moved to Dallas, where they helped promote the arts.

Dallas was incorporated as a town in 1856. The town became a stop for stagecoaches. During the American Civil War (1861-1865), Dallas served as a camp and an administrative center for the Confederate Army.

Commercial growth. Dallas was incorporated as a city in 1871. The city's financial growth began in the 1870's, when two railroad lines—the Houston and Texas Central and the Texas and Pacific—reached Dallas and formed a junction. Farm tool manufacturers then began opening branches in Dallas. Cotton production boomed after rail shipment of the crop became possible. Dallas got its first telegraph line in 1872. By 1890, Dallas was the largest city in Texas, with 38,067 people.

By 1930, the Dallas population had grown to 260,475, but Houston had replaced it as the state's largest city. Discovery of the great East Texas oil field 100 miles (160 kilometers) east of Dallas in 1930 helped boost the city's economy and growth.

World War II (1939-1945) brought aircraft plants and other defense industries to the city. After the war, Dallas became a leading U.S. center for the manufacture of electrical and electronics equipment and aircraft and missile parts. Many large companies, including Chance Vought Aircraft (now part of LTV Corporation), moved to Dallas. Companies founded in Dallas, such as the electronics manufacturer Texas Instruments Incorporated and the computer services company Electronic Data Systems, also expanded rapidly. Industrial growth helped the city's population increase from 294,734 in 1940 to 844,401 in 1970. During this time, many Dallasites moved from the city to the suburbs.

On Nov. 22, 1963, Dallas was the site of President John F. Kennedy's assassination. Vice President Lyndon B. Johnson was sworn in as president later that day aboard the presidential plane at Dallas Love Field airport.

During the early 1960's, the population and economy of Dallas continued to expand. Mayor Erik Jonsson and city leaders turned to the "Goals for Dallas" program to plan for the city's future. In 1967, Dallas voters passed a $175-million bond issue—the largest in the city's history—to fulfill some of these goals. The plans helped promote the construction of the Dallas/Fort Worth International Airport, which opened in 1974. Dallas also built a new city hall and the Martin Luther King, Jr., Community Center. The center provides many social services, such as rent assistance for poor people.

Large companies continued to move their headquarters to Dallas in the 1970's. New construction continued until the mid-1980's, when oil prices fell, the real estate market declined, and Dallas experienced serious economic problems. Financial recovery began in the early 1990's. At that time, the city had over 1 million people.

Recent developments. In 1995, Ron Kirk was elected mayor of Dallas. He became the city's first African American mayor. Kirk won reelection in 1999 but resigned from office in 2001 to run for a seat in the U.S. Senate.

Henry K. Tatum

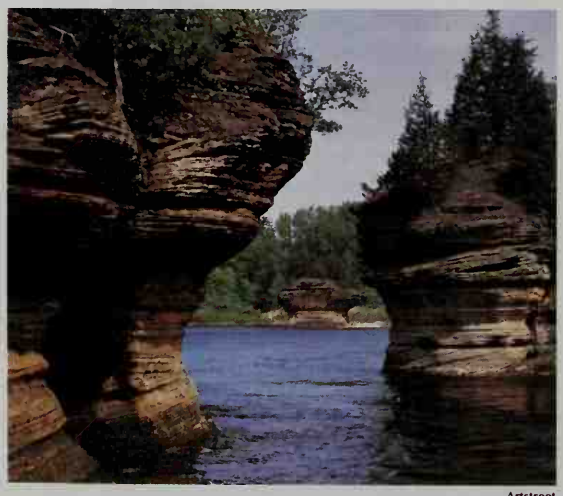
See also **Fort Worth; Johnson, Lyndon B.** (picture); **Kennedy, John F.** (pictures); **Texas.**

Dallas, George Mifflin (1792-1864), served as Vice President of the United States from 1845 to 1849 under President James K. Polk. He was a loyal supporter of Polk's policies. His tie-breaking vote in favor of a low tariff bill that Polk favored in 1846 destroyed him politically in Pennsylvania, his home state.

Dallas served as a Democratic U.S. senator from Pennsylvania from 1831 to 1833, as minister to Russia from 1837 to 1839, and as minister to England from 1856 to 1861. While in England, he helped settle disputes over the Clayton-Bulwer Treaty (see **Clayton-Bulwer Treaty**). Dallas also held office as mayor of Philadelphia, U.S. district attorney, and attorney general of Pennsylvania. In addition, he was secretary to Albert Gallatin, the U.S. diplomat who helped negotiate an end to the War of 1812. Dallas was born in Philadelphia. Michael F. Holt

See also **Vice President of the United States** (picture).

Dalles, *dalz,* are deep gorges where rivers flow rapidly over, or have cut through, hard rock or slabs. The name comes from a French word meaning *slab* or *tile.* The singular form of dalles in English is *dell,* and in many parts of the country these gorges are called *dells* instead of *dalles.* French explorers gave the name *dalles* to scenic gorges of North American rivers, especially those in the northern part of the United States. Notable dalles in the United States include the Wisconsin Dells on the Wisconsin River, near Wisconsin Dells, Wis.; the Saint Louis River Dalles near Duluth, Minn.; the Saint Croix River Dalles between Wisconsin and Minnesota; and The Dalles on the Columbia River between Oregon and Washington. See also **Wisconsin** (Places to visit; picture); **Wisconsin River.** Richard G. Reider



Artstreet

Dalles, also called *dells,* are deep gorges. The scenic Wisconsin Dells, *above,* are located on the Wisconsin River.

Dallin, *DAL ihn,* **Cyrus Edwin** (1861-1944), an American sculptor, used American Indian life as the theme for many of his greatest works. *The Appeal to the Great Spirit* (1908) shows his realistic and dramatic style. Other works include *Signal of Peace* (1890), *Medicine Man* (1899), *Brigham Young and the Pioneers* (1900), and *Paul Revere* (1940). His *Sir Isaac Newton* (1895) is in the Library of Congress in Washington, D.C.

Dallin was born in Springville, Utah. He studied at the École des Beaux-Arts and the Académie Julian in Paris. He taught sculpture in Boston for over 40 years. George Gurney

See also **Massasoit** (picture).

Stuart Cohen, Stock, Boston

Dallin's *The Appeal to the Great Spirit* is a bronze statue that stands outside the Museum of Fine Arts in Boston.

Dalmatian, *dal MAY shuhn,* is a medium-sized dog. It is white, covered with many black or liver-colored spots. Dalmatian puppies are pure white when born. The spots appear after about three or four weeks. Dalmatians make good watchdogs. They are alert, curious, clean, and useful. They also can be taught to hunt. Another name for the Dalmatian is the *coach dog.* These dogs used to run along between the wheels of coaches or carriages, and were companions to the horses. The breed was named for Dalmatia, an area on the Adriatic Sea, but experts are not sure where the dogs were first raised. See also **Dog** (picture: Nonsporting dogs).

Critically reviewed by the Dalmatian Club of America

Dalton, John (1766-1844), an English chemist, proposed an atomic theory of matter that became a basic theory of modern chemistry. His theory, first presented in 1803, states that each chemical element is composed of its own kind of atoms, all with the same relative weight. It explained why a fixed weight of one substance always combines with a fixed weight of another substance in forming a compound.

Dalton was born in Eaglesfield, near Carlisle. In 1794, Dalton published the first major study of color blindness, an affliction he had. In 1802, he published a law now known as *Dalton's law of partial pressures.* The law states that the total pressure exerted by a mixture of gases is the sum of the pressures of all individual gases in the mixture. Melvyn C. Usselman

See also **Atom** (The birth of the modern atomic theory); **Chemistry** (Dalton's atomic theory).

Daltonism. See **Color blindness.**

Dam is a barrier placed across a river to stop the flow of water. Dams vary in size from small earth or rock barriers to concrete structures that rise as high as a skyscraper. People have always had to gather water during wet seasons to have enough for themselves, their animals, and their crops in dry spells.

Throughout history, wherever people settled, an important first concern was to locate an adequate water supply. In many regions, streams full of water during certain seasons of the year become dry at other times, perhaps when water is most needed. At first, people built small dams of brush, earth, and rock that would store enough water for immediate needs. But floods frequently washed these small dams away. As communities grew and populations increased, people learned to construct larger dams that would provide a more permanent and abundant water supply. These dams could store enough water to meet people's needs during seasonal drops in the water supply and during drought periods covering several years. Later, people learned how to harness the energy of falling waters and use it to produce electric power for homes and industries.

What does a dam do?

As a barrier across a river or stream, a dam stops the flow of water. A dam stores the water, creating a lake or reservoir above it. The stored water is then made available for irrigation, town and city water supplies, and many other uses. The dam also raises the water surface from the level of the original riverbed to a higher level. This permits water to be diverted by the natural flow of gravity to adjacent lands. The stored water also flows through hydraulic turbines, producing electric power that is used in homes and industries. Water released from the dam in uniform quantities assures water for fish and other wildlife in the stream below the dam. Otherwise, the stream would go dry there. Water released in larger quantities permits river navigation throughout the year. Where dams create large reservoirs, floodwaters can be held back and released gradually over longer periods of time without overflowing riverbanks.

Reservoirs or lakes created by dams provide recreational areas for boating and swimming. They give refuge to fish and wildlife. They help preserve farmlands by reducing soil erosion. Much soil erosion occurs when rivers flood their valleys, and swift floodwaters carry off the rich topsoils.

Types of dams

Dams are classified by the material used to construct them. Dams built of concrete, stone, or other masonry are called *masonry dams.* Dams built of earth or rocks are called *embankment dams.* Engineers generally choose to build embankment dams in areas where large amounts of earth or rocks are available.

Masonry dams. Today, nearly all masonry dams are built of large blocks of concrete. There are three main kinds of masonry dams: *gravity, arch,* and *buttress.*

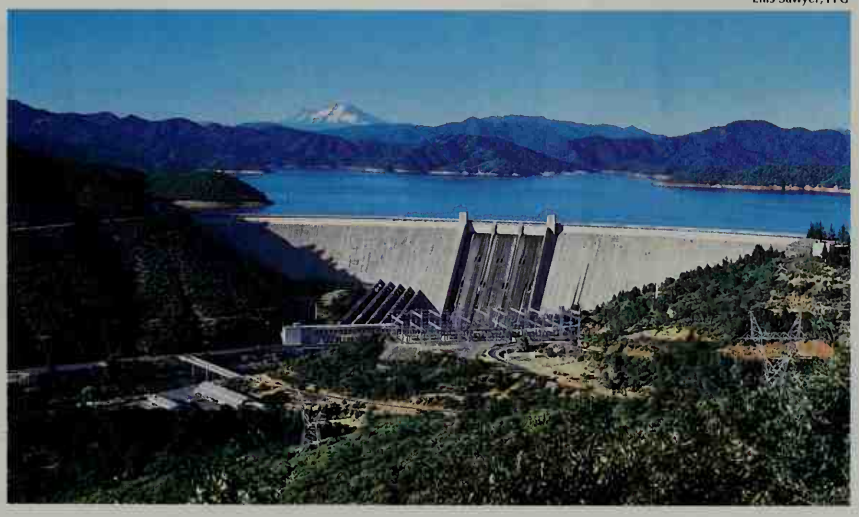
Gravity dams depend entirely on their own weight to resist the tremendous force of the oncoming water. They are the strongest and most massive dams built today. A gravity dam is built on a solid rock foundation. The dam transfers the force of the water downward to the foundation below. Gravity dams can hold back enormous amounts of water. However, they are costly to build because they require so much concrete.

Arch dams curve outward toward the flow of water. They are usually built in narrow canyons. As the water pushes against the dam, the arch transfers the water's force outward to the canyon wall. An arch dam requires much less concrete than a gravity dam of the same length.

Buttress dams depend for support on a series of vertical supports called *buttresses.* The buttresses run along the dam's *downstream face*—that is, the side facing away from the water's flow. The downstream face of a buttress dam usually slopes outward at about a 45-degree angle. The sloping face and the buttresses serve to transfer the force of the water downward to the dam's foundation. Buttress dams, like gravity dams, are usually built in

Larry W. Mays, the contributor of this article, is Professor and Chairman of the Department of Civil Engineering at Arizona State University.

Ellis Sawyer, FPG



Shasta Dam in California creates a huge reservoir on the Sacramento River. It is one of the highest gravity dams in the United States.

U.S. Army Corps of Engineers Fort Peck Project

Fort Peck Dam is one of the largest earth-fill dams in the world. It extends about 4 miles (6 kilometers) across the Missouri River in northeastern Montana. The dam controls flooding, provides irrigation water, and generates electric power for the area.

wide valleys where long dams are needed.

Embankment dams are constructed of materials dug out of the ground, including rocks, gravel, sand, silt, and clay. They are also known as *fill dams.* An *earth-fill dam* is an embankment dam in which compacted earth materials make up more than half the dam. Earth-fill dams are constructed by hauling the earth materials into place and compacting them layer upon layer with heavy rollers. The materials are graded by density, and the finest, such as clay, are placed in the center to form a waterproof core. In some cases, concrete cores are used. The coarser materials are placed outside the core and covered with a layer of rock called *riprap.* The riprap serves as an outer protection against water action, wind, rain, and ice. In addition, thinned-out cement, called *grout,* is pumped into the foundation to fill cracks. This process makes the foundation watertight.

Where rocks are available, it may prove most economical to build a *rock-fill dam.* Most dams of this type are constructed of coarse, heavy rock and boulders. Many of them have a covering of concrete, steel, clay, or asphalt on the upstream side. This covering makes the dam watertight. Combinations of rock and earth result in a type of dam called an *earth-and-rock-fill dam.*

Other types of dams. *Timber dams* are built where lumber is available and the dam is relatively small. The

Larry W. Mays

The Feitsui Dam in Taiwan is a large concrete arch dam. The arch transfers the water's force outward to the canyon walls.

World's highest and largest dams

Highest dams

Dam	Location	Type	Height		Completed
			feet	meters	
Nurek	Tajikistan	Earth-fill	984	300	1980
Grand Dixence	Switzerland	Gravity	935	285	1961
Inguri	Georgia	Arch	892	272	1980
Vajont	Italy	Arch	859	262	1960
Manuel M. Torres	Mexico	Rock-fill	856	261	1980
Alvaro Obregon	Mexico	Gravity	853	260	1946
Mauvoisin	Switzerland	Arch	820	250	1957
Alberto Lleras C.	Colombia	Rock-fill	797	243	1989
Mica	Canada	Earth-fill	797	243	1972

Largest dams*

Dam	Location	Type	Volume		Completed
			cubic yards	cubic meters	
Tarbela	Pakistan	Earth-fill/ Rock-fill	138,600,000	106,000,000	1976
Fort Peck	United States	Earth-fill	125,600,000	96,100,000	1937
Lower Usuma	Nigeria	Earth-fill	121,600,000	93,000,000	1990
Tucurui	Brazil	Earth-fill/ Gravity/ Rock-fill	111,400,000	85,200,000	1984
Ataturk	Turkey	Earth-fill/ Rock-fill	110,500,000	84,500,000	1990
Yacyreta	Paraguay/ Argentina	Earth-fill/ Gravity	105,900,000	81,000,000	1994
Oahe	United States	Earth-fill	92,000,000	70,300,000	1960
Guri	Venezuela	Earth-fill/ Gravity	91,600,000	70,000,000	1986

*Based on volume of dam structure.
Source: United States Committee on Large Dams.

timber is weighted down with rock. Planking or other watertight material forms the facing. *Metal dams* have watertight facings and supports of steel.

Dams with movable gates are built where it is necessary to let large quantities of water, ice, or driftwood pass by the dam. A *roller dam* has a large roller located horizontally between piers. It can be raised and lowered to allow ice and other materials to pass through the dam without much loss of reservoir water level.

How dams are built

Planning. In order to construct a dam, the builders must first gather and study much information. The site where the dam is to be erected must be examined for its formation, quality of foundation, and the availability of suitable construction materials. A careful analysis must be made of the stream-flow characteristics. The area to be covered by the reservoir that the dam creates must be outlined when determining the height of the dam at any given site. This requires detailed topographic mapping and geologic studies. Subsurface drillings are necessary to determine the condition, quality, and location of the rock formation under the damsite.

All property in the reservoir area must be bought or relocated. This occasionally requires the relocation of entire towns, highways, railroads, and utilities. Engineers must also determine the amount of mud, silt, and debris which the dam will stop. This will determine the useful life of the reservoir, because when the reservoir becomes filled with this material it can no longer store water. If the dam is to be used for generating power, outlets must be provided which will connect to generating equipment. If the water is to be used for irrigation or municipal supply, outlets to control its release to canals or aqueducts must be built.

Construction. When the damsite has been selected, means must be found to remove or bypass the flow of the stream from the riverbed so that the foundation can be excavated and the concrete, earth, or rock placed. To divert the flow of the river from the area, frequently half of the riverbed is excavated at one time. The other half of the riverbed is used for the flow of the river. In some cases, it is more economical to bore a tunnel through an adjacent canyon wall. The tunnel permits the entire flow of the river to pass around the damsite. To accomplish this diversion, *cofferdams* (small dams placed temporarily across a stream) are built upstream to divert the river into the tunnel. After the dam has been built high enough, the diversion tunnel is closed with gates, and permanently plugged.

Dam safety. In designing the dam, some provision must be made to bypass water when the reservoir is full, without overtopping the dam. For this purpose, a *spillway* is constructed. Spillways act as safety valves by releasing excess waters that the reservoir cannot contain. A spillway may be a channel apart from the dam or a section of the dam over which water can flow freely. The excess water flows from the reservoir through the spillway and back to the downstream river or drainage channel. A spillway must be large enough to handle the water from a major flood.

Dams can create serious safety hazards. If a dam collapses, it can cause enormous property damage, injury, and sometimes death. A dam can collapse because of faulty construction or an earthquake. Erosion can also lead to a dam's collapse. A dam can be eroded from the inside by water leaking into the embankment, the foundation, or structures attached to the dam. If the spillway is too small, water may flow over the top of the dam and cause erosion.

History

Dams have influenced civilization for thousands of years, especially cultures that depended on irrigation. The Egyptians built the earliest known dam on the Nile River about 2800 B.C. But dams probably were built much earlier. The ancient Romans built dams of cut stone throughout the Roman Empire. Some of these dams are still in use today.

The earliest dams in North America provided power for grist mills and sawmills. American colonists probably built their first dam in 1634 to operate a sawmill in South Berwick, Maine. In the 1800's, significant advances were made in the design and construction of masonry dams, especially in Europe. Dams built in the United States during the late 1800's and early 1900's supplied

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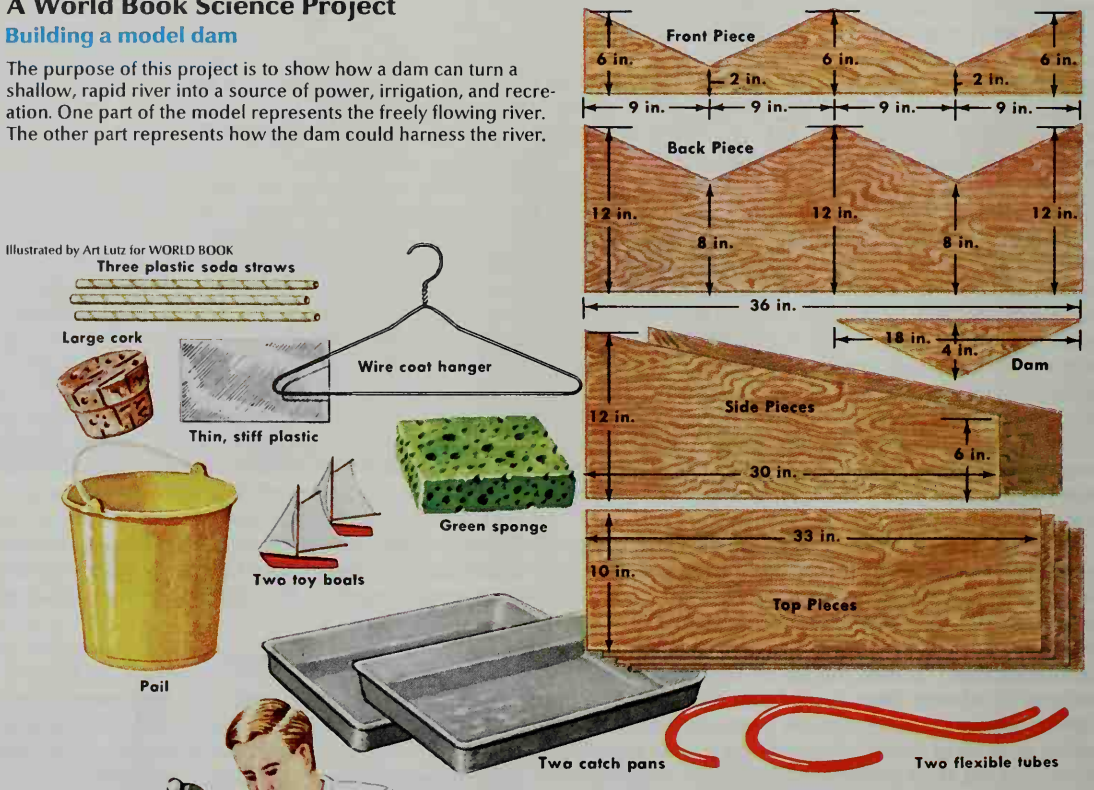
U.S. Army Corps of Engineers Fort Peck Project

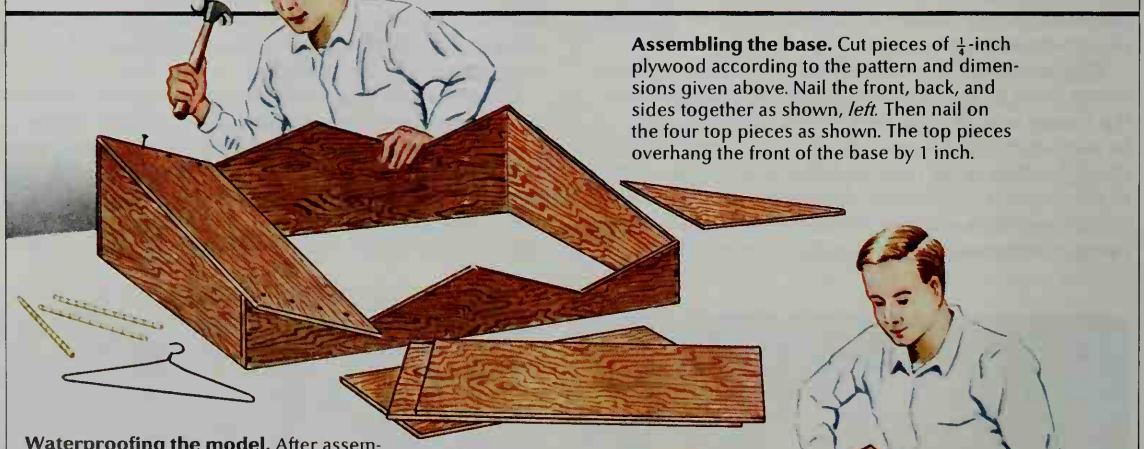
Water from Fort Peck Dam's reservoir is used by two powerhouses, *left,* to generate electricity. The dam's spillway, *right,* carries excess water to the Missouri River.

A World Book Science Project

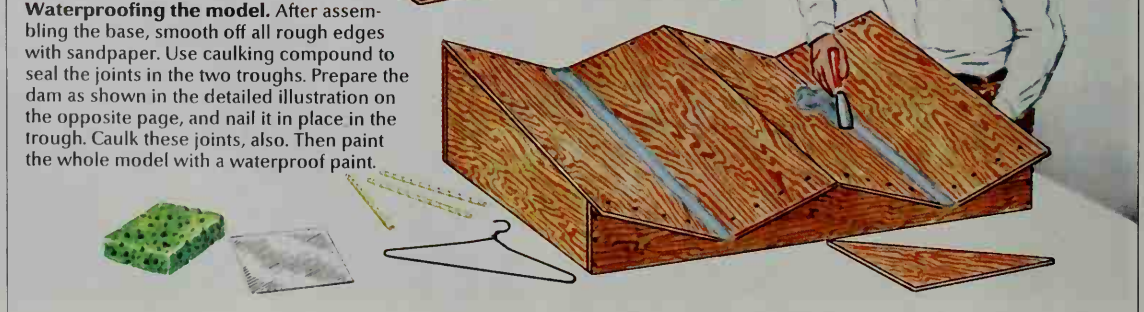
Building a model dam

The purpose of this project is to show how a dam can turn a shallow, rapid river into a source of power, irrigation, and recreation. One part of the model represents the freely flowing river. The other part represents how the dam could harness the river.



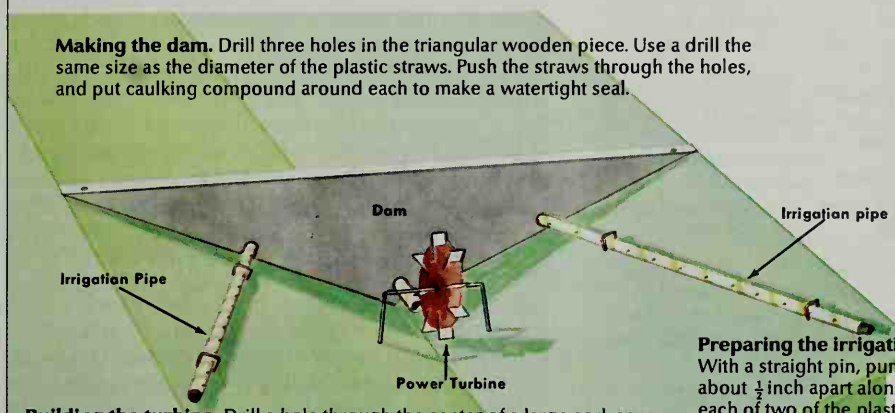


Assembling the base. Cut pieces of $\frac{1}{4}$-inch plywood according to the pattern and dimensions given above. Nail the front, back, and sides together as shown, *left.* Then nail on the four top pieces as shown. The top pieces overhang the front of the base by 1 inch.

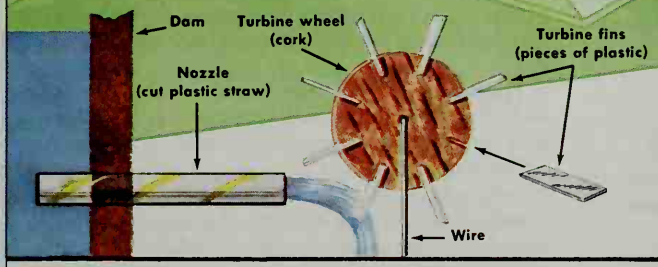


Waterproofing the model. After assembling the base, smooth off all rough edges with sandpaper. Use caulking compound to seal the joints in the two troughs. Prepare the dam as shown in the detailed illustration on the opposite page, and nail it in place in the trough. Caulk these joints, also. Then paint the whole model with a waterproof paint.

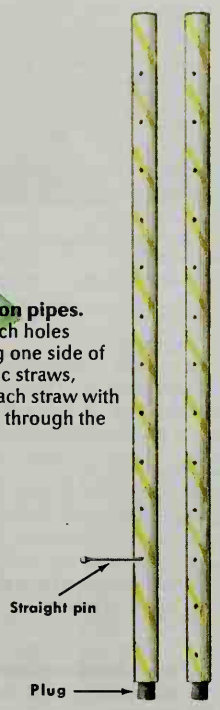
Making the dam. Drill three holes in the triangular wooden piece. Use a drill the same size as the diameter of the plastic straws. Push the straws through the holes, and put caulking compound around each to make a watertight seal.



Building the turbine. Drill a hole through the center of a large cork as shown below. Make notches around the cork and insert the turbine fins, which may be pieces of tin, or thin, stiff plastic. Cut a piece of wire from a coat hanger and push the wire through the hole. Bend the wire and fasten it to the base near the dam. Be sure the cork can turn freely on the wire.

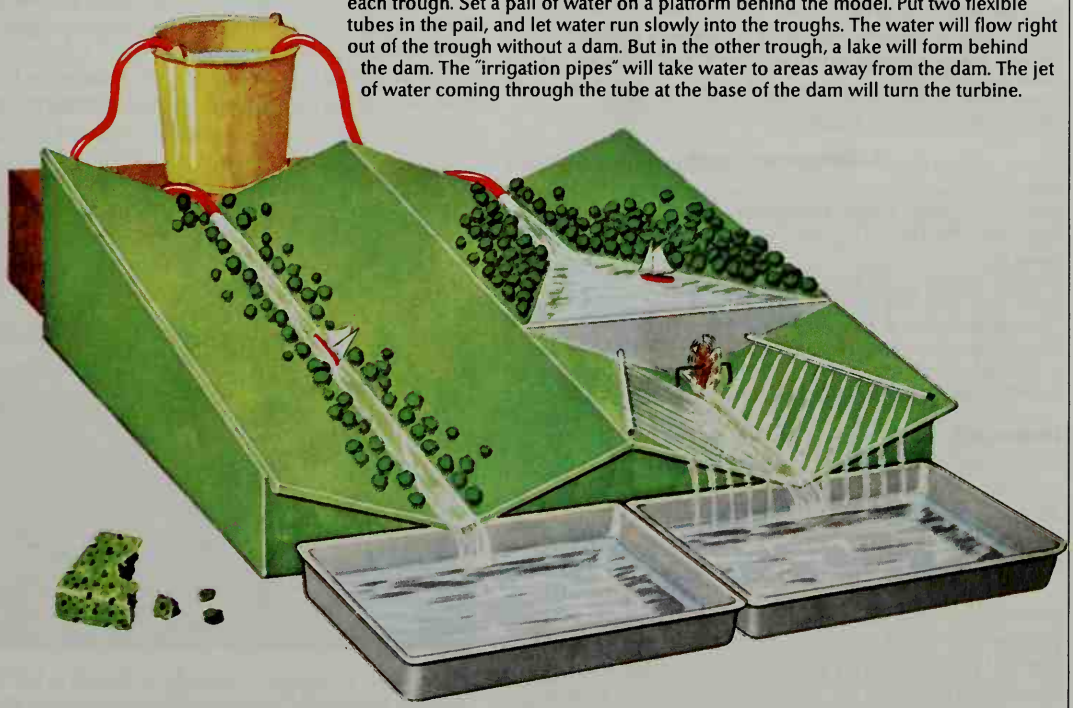


Preparing the irrigation pipes. With a straight pin, punch holes about $\frac{1}{2}$ inch apart along one side of each of two of the plastic straws, *right.* Plug one end of each straw with clay. Push the other end through the dam as shown above.



How the model works

Demonstrating the project. Glue small pieces of green sponge to represent trees in each of the troughs. Place catch pans under the overhang at the front of each trough. Set a pail of water on a platform behind the model. Put two flexible tubes in the pail, and let water run slowly into the troughs. The water will flow right out of the trough without a dam. But in the other trough, a lake will form behind the dam. The "irrigation pipes" will take water to areas away from the dam. The jet of water coming through the tube at the base of the dam will turn the turbine.



water to dry lands in the West and opened the area to settlement. During the 1900's, improvements in engineering techniques and building materials led to the construction of higher and longer dams than ever before. These dams brought electric service to remote areas and water to arid regions. Larry W. Mays

Related articles in *World Book.* See the *Electric power* section of various state, province, and country articles, such as **Alabama** (Electric power). See also:

Dams

Aswan High Dam
Bonneville Dam
Fort Peck Dam
Fort Randall Dam
Garrison Dam
Glen Canyon Dam
Grand Coulee Dam
Hoover Dam
Oroville Dam
Owyhee Dam
Pensacola Dam
Roosevelt Dam
Shasta Dam
Tarbela Dam
Three Gorges Dam

Other related articles

Arizona (picture)
Brazil (picture: The Itaipú Dam power plant)
Electric power
Energy supply (Water power)
Flood
Irrigation
Kentucky Lake
Lake (picture)
Reservoir
Rio Grande Project
Saint Lawrence Seaway (The hydroelectric power project)
Tennessee Valley Authority (The dams)
Turbine (Water turbines)
Water power

Outline

I. What does a dam do?
II. Kinds of dams
A. Masonry dams
B. Embankment dams
C. Other types of dams
III. How dams are built
A. Planning
B. Construction
C. Dam safety
IV. History

Questions

Why do we need dams?
What is the world's highest dam? The world's largest dam?
How do dams help farmers?
What materials are commonly used in building a dam?
How do builders decide where to construct a dam?
What is a *cofferdam?*
Under what circumstances are *roller dams* necessary?
What is the purpose of a *spillway?*

Additional resources

Level I

Ardley, Neil. *Dams.* Garrett Educational, 1990.
Dunn, Andrew. *Dams.* Thomson Learning, 1993.

Level II

Jackson, Donald C., ed. *Dams.* Ashgate, 1997.
Le Moigne, Guy, and others, eds. *Dam Safety and the Environment.* World Bank, 1990.
Martin, Russell. *A Story That Stands Like a Dam.* 1989. Reprint. Univ. of Ut. Pr., 1999.
Schnitter, Nicholas J. *A History of Dams.* A. A. Balkema, 1994.

Damages, in law, means money that a court orders one person to pay to another person for violating that person's rights or for breaking a contract. To collect damages, a victim ordinarily must show that loss or injury has been suffered because of the other person's fault or carelessness or breach of contract.

The main types of damages include *compensatory, general, nominal,* and *punitive* damages. Compensatory damages are recovered only for actual damage, such as the cost of repairing an automobile damaged in an accident. Most damages are compensatory. General damages are based on indications of harm, including pain and suffering. They are awarded most often in *libel* and *slander* cases where it may be hard to show how one's reputation was harmed by a person making false statements. Nominal damages are small token awards given in cases where a person's rights have been violated, but where no harm has occurred. Suits fought on principle are often settled in this way. Punitive damages are in effect a fine levied against the wrongdoer. They are given in addition to other damages, when the wrongdoer has purposely harmed the other person.

There are few rules of law on how to measure damages. Damages may vary with each case, because the circumstances may be different. Also, many damage suits are tried before juries, and each jury may award different damages. Damages may include elements that are hard to measure in money, such as pain and suffering. Some damages may have to be measured for harm that will occur only in the future. Sherman L. Cohn

See also **Negligence; Tort.**

Damascus, *duh MAS kuhs* (pop. 1,394,000), is the capital of Syria. It may have been founded about 5,000 years ago and is one of the world's oldest cities. Damascus is Syria's cultural, economic, and political center. It lies in southwest Syria, between the Anti-Lebanon Mountains on the west and the Syrian Desert on the east (see **Syria** [map]).

The city is on an oasis in a semiarid plain. The Barada River flows through Damascus and has provided the area with water for thousands of years.

The southern section of the city includes an area that is hundreds of years old. There, on narrow, winding streets, merchants sell a variety of goods in bazaars called *suqs,* just as their ancestors did. This area contrasts with the main business district in the northwest, which has many tall buildings erected during the 1900's.

Many parts of Damascus and its suburbs have residential areas. Most of the people live in apartments, but some have beautiful houses.

Cultural attractions in Damascus include the University of Damascus, the National Library, museums, and

Shostal

Damascus is the capital of Syria. Some sections of the city are hundreds of years old, but the main business district, *shown here,* has many buildings erected in the 1900's.

theaters. The city has many fine works of Islamic architecture. Among them are the Umayyad, or Great Mosque; the Mosque of Sultan Süleyman; and the tomb of Saladin, a Muslim leader of the 1100's.

Economy. Damascus is the chief Syrian center of manufacturing, trade, tourism, and banking and other financial activities. Textile production and food processing are two of the city's largest industries. Fruit grown in nearby orchards is processed and canned in Damascus. In the old section of the city, craftworkers sell fabrics, metalware, and many other products. Most of the people of Damascus use buses and taxis for local transportation. An international airport lies just outside the city.

History. Historians believe Damascus may have been founded about 3000 B.C. The city was important during the rule of several early empires, including those of the Assyrians, Greeks, Romans, and Byzantines. The Muslim Arabs captured Damascus from the Byzantines in A.D. 635. Under the leadership of the Umayyad dynasty, the Muslim Arabs made Damascus the capital of their vast empire in 661. But the Umayyads lost control of Damascus during the 700's, and the city went through a long period of anarchy and decline.

In 1154, the Syrian leader Nur al-Din made Damascus the capital. Saladin, the Muslim ruler of Egypt, took control of Damascus in the late 1100's. The city became a center of trade. Most of its main historical monuments date from the late 1100's and the 1200's.

In 1516, the Ottoman Empire conquered Damascus. The city thrived as trade increased with neighboring countries and with European nations. The Ottomans controlled the region until World War I (1914-1918). Combined Allied and Arab forces captured Damascus during the war. France took control of Syria in 1920.

Syria became independent in 1946, with Damascus as its capital. By the early 1980's, the city had almost four times as many people as it had in 1946, and a housing shortage resulted. New towns were established near Damascus to solve the problem. Malcolm C. Peck

See also **Khalid ibn al-Walid; Syria** (picture).

Damask, *DAM uhsk,* is a firm, lustrous fabric that may be woven from any fiber. Its flat, woven design appears on both sides of the fabric. Damask was originally a silk fabric produced in China. Traders introduced it to Europe by way of Damascus, Syria.

In table damask, the design may be sateen weave with *floats* (longer, raised threads) in the *filling* (crosswise) threads. The background may be a satin weave with floats in the *warp* (lengthwise) threads. Single table damask has a four-float construction, and double damask has a seven-float construction. Damask's luster depends on length of floats, length of fibers, closeness of weave, and uniformity of yarns. Christine W. Jarvis

D'Amboise, *dahm BWAZ,* **Jacques,** *zhahk* (1934-), an American dancer, won fame as a featured performer with the New York City Ballet. He earned particular recognition as the male lead in George Balanchine's ballet *Apollo.* Athletic jumps and a sparkling stage presence marked his style.

Jacques Joseph d'Amboise was born on July 28, 1934, in Dedham, Massachusetts. He trained under Balanchine at the School of American Ballet. D'Amboise is especially remembered for roles in the ballets *Western Symphony* (1954), *Movements for Piano and Orchestra* (1963), and *Meditation* (1963). As a *choreographer* (creator of dances), d'Amboise created *Irish Fantasy* (1964) and other ballets.

Carolyn George d'Amboise

Jacques d'Amboise

D'Amboise appeared on television and in motion pictures. In addition, he directed or choreographed several Broadway musicals. In 1976, he established the National Dance Institute to introduce children to the arts through dance. Katy Matheson

Dame school. See **Colonial life in America** (Education).

Damien de Veuster, *DA MYAN duh VUS TAIR,* **Joseph** (1840-1889), was a Roman Catholic priest who gave his life to the care of lepers in a colony at Molokai, Hawaii. Father Damien was born on Jan. 3, 1840, in Belgium and became a member of the Fathers of the Sacred Hearts of Jesus and Mary. He asked to be sent to Molokai as resident priest (see **Hawaii** [Molokai]). But because of the difficulty in getting doctors, Father Damien was obliged to serve as a doctor as well. He was stricken with leprosy in 1885. Hawaii has placed a statue of Father Damien in the United States Capitol in Washington, D.C. Marvin R. O'Connell

Damocles, *DAM uh kleez,* was a member of the court of Dionysius II, who ruled Syracuse, Sicily, from 367 to 344 B.C. Damocles was an excessive flatterer. The Roman orator Cicero said that Damocles once talked too much about the happiness and good fortune of Dionysius. To teach Damocles a lesson, Dionysius invited him to a big feast. When he was seated, Damocles found a sword, suspended by a single hair, dangling over his head. This sword represented the constant danger that went with the wealth and material happiness of Dionysius. The *sword of Damocles* has become a byword for the threat of danger. Peter Krentz

Damon and Pythias, *DAY muhn, PIHTH ee uhs,* were two noble youths in Greek legend. Their friendship and loyalty to each other made them famous. Pythias had been condemned to death by Dionysius, ruler of the city of Syracuse. Pythias was allowed to leave Syracuse to put his affairs in order after Damon agreed to die in his place if Pythias failed to return. Although Pythias was delayed, he arrived just in time to save Damon from death. Dionysius so admired this display of friendship that he pardoned Pythias and asked the two to become his friends. The name of Pythias was originally spelled *Phintias.* During the Middle Ages, scribes accidentally spelled it *Pythias.* That form of the name has been common since the 1500's. William F. Hansen

Damp is any of several dangerous gases found mostly in coal mines. The term probably comes from a German word for *vapor. Firedamp* is the most common type of damp. It consists chiefly of *methane,* a tasteless, odorless, nonpoisonous gas that is lighter than air. Firedamp forms as decaying plant matter changes into coal. It is contained in the coal and becomes trapped in cracks within the coal layer. When miners cut into the coal, they release the gas. Firedamp is flammable. When

mixed in certain proportions with air, firedamp is explosive. *Afterdamp* is a mixture of gases resulting from a mine explosion or fire.

Stinkdamp is *hydrogen sulfide,* a colorless, poisonous gas. It has a strong odor like that of rotten eggs. It forms as iron pyrite and other minerals decompose in the presence of water. Stinkdamp occurs in small quantities.

White damp is *carbon monoxide,* a colorless, odorless, and poisonous gas. It occurs chiefly after blasting or fires and collects near the roofs of mines.

Blackdamp, also called *chokedamp,* is a mixture of nitrogen and carbon dioxide. Blackdamp is denser than air and gathers at low places in mines. If too little oxygen is present, miners will suffocate.

Miners once carried canaries to test for dangerous accumulations of whitedamp and blackdamp. The miners knew dangerous gas was present if a bird collapsed. Today, miners use various mechanical, chemical, and electrical devices to test mine air. William Hustrulid

See also **Methane; Coal** (Mine safety).

Dampier, *DAM pee uhr* or *DAMP yuhr,* **William** (1651-1715), was an English seaman and explorer. He explored Australia and the far South Pacific and wrote one of the first English accounts of the region. His journal, *A New Voyage Around the World* (1697), helped increase English interest in the Pacific. He also increased racial prejudices when he wrote that the people living in Australia were "the miserablest People" in the world.

Dampier was born in East Coker, England. He went to sea as a boy, and joined the navy in 1672. In 1688, he sailed to Australia (then called New Holland). In 1699, he reached Australia again in a voyage financed by the British Admiralty. Dampier also reached New Britain and New Ireland, islands near New Guinea. Robin W. Winks

Damping-off is a plant disease caused by certain fungi that live near the surface of the soil (see **Fungi**). The disease affects many kinds of plants. Damping-off kills *seedlings* (young plants) before they grow above the ground, or it destroys the stems of seedlings just above the surface of the soil. Damping-off cannot be cured. But growers can prevent it by planting seeds in soil free from disease-causing fungi, by treating the seeds or the soil with fungicides, or by introducing microorganisms that use nutrients in the soil vital to the fungi.

Joseph G. Hancock

Damrosch, *DAM rahsh,* **Leopold** (1832-1885), a German-born conductor, was an influential figure in American music. In 1873, he founded the Oratorio Society of New York. He founded the New York Symphony Society in 1878 and was its conductor until his death. He introduced German opera at the Metropolitan Opera House during its second season in 1884 and 1885.

Damrosch was born in Posen, Prussia (now Poznań, Poland). From 1854 to 1858, he was a violinist in the Weimar court orchestra under conductor Franz Liszt. Damrosch came to the United States in 1871 to become conductor of the German Male Choral Society. Walter Damrosch, his son, also became a notable figure in American music. Martin Bernheimer

Damrosch, *DAM rahsh,* **Walter Johannes** (1862-1950), was an American composer, conductor, and music educator. In 1925, he conducted the New York Symphony Orchestra in the first symphonic program ever broadcast on radio. He was musical counsel for the National Broadcasting Company from 1927 to 1947. During those years, children throughout the nation learned about great music by listening to the Music Appreciation Hour he directed. Damrosch created catchy rhymes to accompany the instrumental melodies to help popularize the work of many classical composers.

Damrosch was born in Breslau, Silesia (now Wrocław, Poland). He was the son of conductor Leopold Damrosch. Walter came to the United States with his father in 1871. In 1885, he succeeded his father as director of the Oratorio and Symphony Societies of New York City. In 1894, he founded the Damrosch Opera Company to present the operas of Richard Wagner. Damrosch helped reorganize the Symphony Society in 1903 and then served as its conductor until it merged with the New York Philharmonic Society in 1926. His works include the operas *The Scarlet Letter* (1896), *Cyrano de Bergerac* (1913), and *The Man Without a Country* (1937); choral and orchestral works; and several songs.

Martin Bernheimer

Damsel fly. See **Dragonfly.**

Dana, *DAY nuh,* **Charles Anderson** (1819-1897), editor and part owner of the New York *Sun,* built it into one of the most important newspapers of its time. Dana and his associates paid $175,000 for the *Sun* in 1868. Under his management its value rose to about $5 million. He made the *Sun* a witty, terse, and outspoken newspaper.

Dana was born in Hinsdale, New Hampshire. He studied at Harvard University from 1839 to 1841. In 1841, he became a member of the Brook Farm Association, an experimental social community at West Roxbury, Massachusetts, and wrote for its publications, *The Harbinger* and *The Dial* (see **Brook Farm**). He joined the staff of the New York *Tribune* in 1847 and later became its managing editor. The *Tribune* dismissed Dana in 1862 because he disagreed with *Tribune* owner Horace Greeley about the newspaper's stand on the Civil War. Dana served as an assistant secretary of war from 1863 to 1865.

Joseph P. McKerns

Dana, *DAY nuh,* **Richard Henry, Jr.** (1815-1882), was an American author known for his sea adventure story *Two Years Before the Mast* (1840). The book became one of the most popular and influential sea stories ever written. Herman Melville said Dana's book helped inspire him to write his famous sea novel, *Moby-Dick.*

Dana was born in Cambridge, Massachusetts. He was forced to leave his studies at Harvard University because of poor eyesight caused by an attack of measles. In 1834, Dana sailed as a seaman from Boston around Cape Horn, arriving in California in January 1835. After spending about 17 months in California, he returned by sea to Boston. Dana kept a journal of his two voyages and his visit to California that became the basis of *Two Years Before the Mast.* He wrote the book in the form of a diary, realistically describing life at sea and providing a vivid account of Spanish California in the 1830's.

Dana was active in the antislavery movement before the Civil War (1861-1865) and helped form the antislavery Free Soil Party in 1848. He was also a noted lawyer and wrote *The Seaman's Friend* (1841), a manual of customs, terms, and laws relating to the sea. *To Cuba and Back: A Vacation Voyage* (1859) describes one of Dana's later sea voyages. Edward W. Clark

Danaë. See **Perseus.**

© Sylvain Grandadam, Tony Stone Images

A traditional Japanese dance features colorful costumes and the expressive use of fans. Asian dance typically emphasizes gestures of the head, eyes, and especially the hands and fingers.

Dance

Dance is the movement of the human body in a rhythmic way. Dance serves many functions in human society. It is an art form, a social activity, a type of communication, and a form of recreation. People can dance by themselves, in couples, or in large groups. The dance can be spontaneous or performed in established movements. It can tell a story, explore an emotion, or serve as a form of self-expression. Many people dance as a career, but anyone can dance simply by moving in rhythm.

Dance is among the oldest human art forms. Dancing extends beyond the human species itself. For example, many animals perform complex dances during courtship.

Dance differs from other kinds of rhythmic movement, such as dribbling a basketball, because in dance the movement itself is the goal of the activity. Music usually accompanies dance, providing the rhythm, tempo, and mood for the movements.

In modern societies, many people enjoy dancing simply for entertainment. Each generation creates new dances as an expression of its own sense of life and fun. For example, rock dancing arose about 1960 with the popularity of rock music. This type of dance was created primarily by and for young people. Rock dances such as the *twist* did not require partners to touch each other while they danced. The dancing was free-spirited and individual, allowing each dancer to create his or her own steps spontaneously. Rock dancing stressed pure emotion underscored by the strong beat of the music.

© Joe Viesti

An American square dance is performed by groups of four couples. Many square dances originated in ancient English, Irish, and Scottish folk dances that settlers brought to America.

William Deresiewicz, the contributor of this article, is a professional dance critic. He is also a dance teacher, administrator, and dancer.

Why people dance

Religious reasons. For thousands of years, human beings have danced for religious reasons. Many religions involve some form of dance.

Many religious dances are forms of prayer. Believers dance as they pray for rain, for the fertility of crops, and for success in war or in hunting. Such dances often imitate or pantomime some movement. For example, dancers may imitate the movement of the animal to be hunted, or a hunter's actions in stalking it. They may wear elaborate costumes and masks or makeup to depict deities or animals.

Religious dance also may attempt to create a state of *ecstasy* (intense joy) or trance in the worshiper. Dance may also be used as one part of a religious occasion or ritual. One example is the dancing of Jews at the festival of Simhat Torah. Another example is the dancing and whirling of members of a Muslim religious order called *dervishes*. Dancing was a formal element in Christian worship until the A.D. 1100's, when religious leaders began to prohibit it because they believed it was too worldly an activity. However, spontaneous dance has become a common element of worship among some Protestant denominations.

Social reasons. Dancing plays an important role in social functions. All societies have characteristic forms of dance. Such dancing may take place at ceremonial occasions or at informal gatherings. Like traditional foods and costumes, dance helps members of a nation or ethnic group recognize their connection to one another and to their ancestors. By dancing together, members of a group express their sense of common identity or belonging.

Dance can strengthen social connections. By dancing together, people share an intimate physical experience that is cooperative and harmonious. Social dances tend to form patterns, such as circles and chains, and to involve the mingling of couples. Examples include square dancing and line dancing. These patterns tend to reinforce a sense of unity. Because dancing involves physical contact, it also serves as a symbol of social bonds, such as when the bride and groom dance the first dance at a wedding reception.

Dance is especially important during courtship, which is one reason it is so popular among young people. Like some animals, people dance as a way of attracting a possible mate by displaying their beauty, grace, and vitality.

Recreational reasons. Many people dance for fun. Dancing allows individuals to feel their body moving freely, to release energy, and to express exuberance and joy. Dancing is also good exercise. It allows people to test the limits of what their bodies can do, as they fling their arms out, kick up their legs, and stretch and twist their bodies.

Artistic reasons. In nearly all societies, dance is an important art form. Its unique powers of self-expression and representation come from the fact that dance uses the body directly, without words, images, or sounds. Dance refines and enlarges the natural human tendency to express feelings physically. The skip of joy becomes a ballerina's leap. A stomp of rage can develop into complex patterns of stamping and clapping, as in the flamenco dance of Spain.

When a dance is performed before an audience, it can serve as a form of drama, all the more powerful because it is silent. Spoken theater can better represent complex social situations, but dance can more directly convey deep emotions and spiritual states.

Dances to take part in

Many dances are easy to learn and are designed so that almost anyone can participate in them. Social dances are common modern forms of such dances, which might be called *participatory, shared,* or *communal dances*. The most basic and widespread forms of

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Folk dances celebrate the history and traditions of a particular ethnic or national group. The famous Ballet Folklórico of Mexico is a highly trained company of professional dancers who perform colorful folk dances that reflect the Indian and Spanish roots of Mexican culture.

communal dances are *ritual ethnic dances* and *folk dances*. These two types often overlap, but they differ in their appearance and purpose, and in the occasions on which they are performed.

Ritual ethnic dances have traditionally been performed by peoples in such places as Africa and the Pacific Islands and by American Indians. The dances of these groups show as much variety as their languages. Dances may be performed to mark many different events, such as initiation rituals, funerals, and certain seasons, such as the harvest. But some features are commonly found in ritual ethnic dancing.

Most ritual ethnic dance is performed in groups rather than by solo dancers or by male-female couples. However, some dancers may have a special solo part or act as leader of the group. Groups of men and women usually dance separately, and different types of dances are designed for men or women. The movements of the men are often sharp and vigorous. Those of the women tend to be more subdued or subtle. A group's chiefs and priests often dance more than other members of the group. A leader may display authority by performing a certain type of dance.

Costumes or masks are often used for specific purposes and occasions in ritual ethnic dance. Dancers may also wear tall, spectacular headdresses, or leg rattles that help establish the rhythm of the dance. Ritual ethnic dances are performed in many arrangements, the most common being a circle. The use of the drum is another common feature of ritual ethnic dancing. For many people, a drum is all they need to give a dance its rhythm. But other instruments, such as flutes, stringed instruments, and horns, are also used.

In some dances, participants may work themselves into a frenzy or trance during which they believe a god or spirit takes possession of their body. Such a dance may begin slowly and build to a hypnotic intensity, ending only when the dancers collapse in exhaustion.

The movements of ritual ethnic dances are varied. The most common movement is stamping the foot on the ground. Large groups of dancers can make the ground shake with this action. Other movements include graceful leaps, swirling motions of the pelvis, and wavelike movements or vibrations of the entire body.

Ritual ethnic dance has long served to pass along a people's culture and history to its younger generation. However, some of these dances today are performed only as entertainment and no longer have significance as rituals.

Folk dances. Folk dance is sometimes defined as a dance that developed among the common people, without the aid of choreographers or organizers. Folk dance is sometimes called *ethnic dance* when it celebrates the traditions of a specific ethnic group. Folk dance and ethnic dance are closely related. But some experts consider ethnic dance a type that is always performed in its original form, while folk dance may be changed or adapted over time.

Most folk dances are simple and easy to learn. They usually involve step patterns only, with the arms, head,

Bear Dance, Preparing for a Bear Hunt (1835-1837), an oil painting on canvas by George Catlin; National Museum of American Art, Washington, D.C. (Art Resource)

Religious dances are often forms of prayer. These Native American dancers were dancing to ask for success in bear hunting. The dancers imitated the movements of the bear as they danced. Some dancers wore bear masks to feel they were actually assuming the animal's spirit and powers.

Ballroom dancing is a form of dancing for couples. Various ballroom dances originated in Europe, the United States, and Latin America. These dances then spread throughout the rest of the world as both a popular social activity and a competitive sport.

© Jeffrey Dunn, The Viesti Collection

and body held in a set position. Participants generally join hands or hold each other by the shoulders or around the waist. Most of the dances require only a modest amount of energy, with movement between a walk and a jog. Folk dancers often wear traditional clothing, such as boots; embroidered jackets and skirts; and bright hats, scarves, and leggings.

Folk dance, with its circular formations and linked lines, builds feelings of togetherness. Some folk dances are earthy and vigorous, such as the *Morris dance* from England, with its stamping and high leaps. Other forms are brisk and lively, such as the Italian *tarantella.* The *jig* and the *Highland fling* of Ireland and Scotland feature rapid footwork.

A folk dance may reflect qualities a group or nation especially admires. For example, Russian folk dances, especially those for men, seem to explode with energy. In Spain, such dances as the *flamenco, bolero,* and *fandango* express passion, pride, and sexual desire.

Some folk dances retain elements of their roots in ancient religious observances. The most familiar example is the *Maypole dance,* traditionally celebrated on May 1. Participants in this happy rural dance welcome spring by weaving bright ribbons around a decorated pole as they dance around it. However, the dance originated as an ancient tree-worshiping ceremony practiced by the early settlers in the great forests that once covered Europe.

Many folk dances developed from peasant dances in Europe during the Middle Ages. However, like other aspects of traditional life, folk dance began to disappear in the change from rural to urban society. Starting in the early 1900's, some people attempted to preserve and revive the folk dances of their native lands. Today, most folk dances are performed at festivals and events, where people have a special interest in getting in touch with their roots.

Some types of folk dance were created in the 1900's as a way to build national identity. For example, in Israel, which was founded as a nation in 1948, the people have created new folk dances and adapted old ones, such as the Romanian *hora.* Other folk dances, such as the

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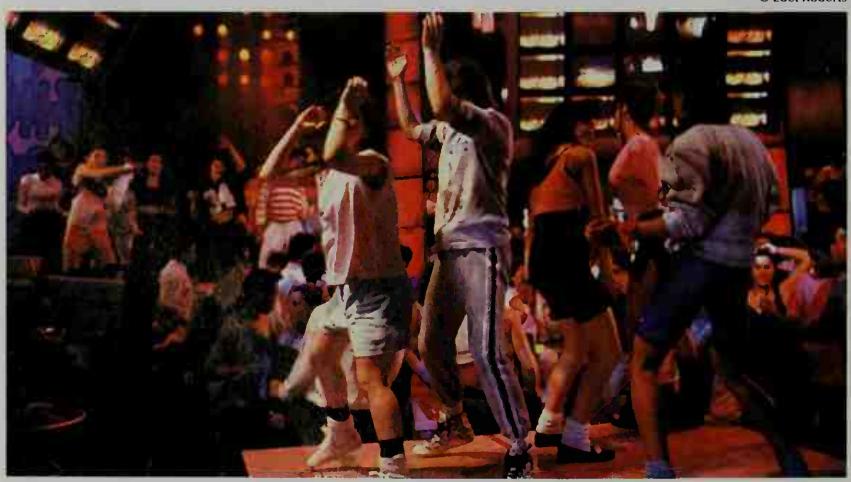

Rock dancing is a popular form of social dancing created by and for young people. Rock dances are free-spirited and encourage individuals to make up their own steps. Young men and women often perform rock dances without touching any other dancers.

Emperor Franz Joseph at a Ball in Vienna (about 1900), a gouache painting on canvas by Wilhelm Gause; Museum der Stadt, Vienna, Austria/ET Archive, London, from Superstock

The waltz became the most fashionable social dance of the 1800's. It originated in Germany and Austria and soon spread to other countries. The waltz inspired some of the finest dance music of the period and also added beauty and elegance to many romantic ballets of the 1800's.

American square dance, are modern developments of older forms.

Social dances. In addition to developing into today's folk dances, the peasant dances of medieval Europe also evolved into a third type of participatory dance, called *social dance*. In social dancing, people in modern societies dance for personal pleasure. Each generation creates its own type of social dance to express its own sense of life and fun.

Social dances emerged in the late Middle Ages as the European aristocracy began to modify the dances of the common people to make the dances more suitable for the court. The traditional circle dances began to acquire more elegance and refinement. Dancers paid more attention to details of etiquette and technique, such as how to approach one's partner and how to hold one's head. Soon dancing came to be regarded as the best way to teach the graceful body movement and gracious behavior expected of the courtier.

In the late 1600's and early 1700's, King Louis XIV of France brought aristocratic life to a high state of development. Louis was especially dedicated to the art of the dance. Courtly dances of his time included the gigue, minuet, and pavane. The French court of the early 1700's also adapted English country dances into formal dances for groups of eight. These dances, called *cotillon,* soon became popular in England and other European countries. Eventually, these formal dances were carried to the United States, where their name was changed to *cotillion*. Today, a formal ball is frequently referred to as a cotillion.

Until about 1800, court dancing emphasized group participation. Then a new kind of social dance arose that put the man and woman into a dance world of their own as partners. These dances became known as *ballroom dances* because they were performed in large ballrooms. The first ballroom dance was the waltz, a light and gracious turning dance that was popularized in Vienna, Austria, and rapidly swept throughout Europe. At first the waltz caused some controversy. Never before had men and women danced so closely together.

After the waltz gained widespread acceptance, it was joined by other social dances. Many Latin American ballroom dances were introduced in the early 1900's, including the tango, rumba, and samba. Ballroom dancing has now become an international sport, with competitions held in a number of dance categories.

During the 1960's, another new type of social dance was born that gained popularity among young people. This type, based on rock music, shifted the emphasis from the couple to the individual. At concerts and parties, rock dancing meant "doing your own thing" in the individual's own style and space on the dance floor. With the strong beat of the music and the desire to be

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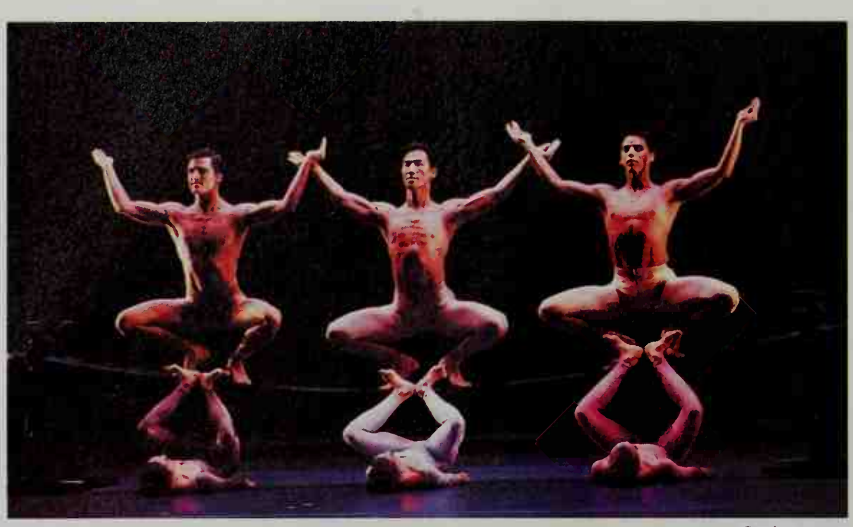
Dancers from Bali perform with their legs bent and their feet flat on the ground. They keep their torsos, elbows, and wrists flexible, creating movements that are harmonious and fluid.



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Modern dance introduced a revolutionary style of dance during the 1900's. One of the central figures in modern dance was American choreographer and dancer Martha Graham. She created *Maple Leaf Rag,* her final work, *shown here,* in 1990. Although many of Graham's dances were serious or even tragic, *Maple Leaf Rag* had a lighthearted quality, with music by American ragtime composer Scott Joplin.

spontaneous and free, dance was returning to its roots in ecstasy and pure emotion.

Dances to watch

The world has two great traditions of what is usually called *theatrical dance,* the Asian tradition and the European and American tradition. Both traditions employ movements of great beauty, intricacy, and difficulty to convey emotional states and artistic ideas. Both require that the performers undergo long and rigorous training to develop the necessary control of their bodies as well as the necessary expressive qualities. For this reason, unlike participatory or communal dances, theatrical dances are usually performed by professional dancers or dedicated amateurs.

Asian theatrical dance is primarily religious in nature. In such Asian religions as Hinduism and Buddhism, dance remains a strong link between the faithful and their gods. Asian dance primarily tells stories, acts out prayers, or recounts myths of deities and heroes. It emphasizes gestures of the head, eyes, and especially the hands and fingers. Through these gestures, performers express the story's fine points and details. Asian dance also features elaborate costuming and bodily decoration, such as ankle bells, shining head pieces, and beautiful robes. Asian dancers also may wear expressive masks that represent certain types of characters.

The movements of Asian dance are generally harmonious and fluid. The dancer stands strongly on bent legs, feet flat and solid on the ground. The body is held erect, and the elbows and wrists are flexible. The changing angles of the elbows and wrists help to shape poses and gestures. The performer's face is active. The eyes dart, and the mouth grimaces or smiles. The toes usually point upward, while the heels may stamp out complex rhythms. The whole effect is one of great poise, even amidst the most vigorous action.

The Asian theatrical dance tradition originated in India. There are four major forms of Indian dance: (1) *bharata natyam,* (2) *kathakali,* (3) *kathak,* and (4) *manipuri.*

The most important form is *bharata natyam,* a solo dance traditionally performed in temples by female dancers called *devadasis.* Bharata natyam, like other forms of Indian dance, includes a vocabulary of symbolic gestures called *mudras* or *hastas.* Each of these gestures may have a variety of meanings. Bharata natyam is danced to classical Hindu religious poetry and is accompanied by a drummer, a singer, and sometimes other musicians as well.

The *kathakali* presents stories from the *Ramayana* and the *Mahabharata,* the great epic poems of Hinduism. Themes from the *Puranas,* which are long Hindu stories told in verse, may also be used. Kathakali is physically demanding and typically requires dancers to support their weight on the outside edges of their feet.

Kathak is a form that mingles Hindu and Muslim influences. It requires great technical skill and involves speedy footwork and spectacular turns.

Manipuri is more like folk dancing. This form of dance blends solo and group dancing as it tells stories of the Hindu god Krishna.

Throughout Southeast Asia, classical Indian dance combined with local traditions to create distinctive national forms. Cambodian dancers train their fingers, elbows, and other joints to stretch well beyond the natural range. This enables them to perform odd contortions and movements that display a delicate beauty. Dance in Myanmar (formerly called Burma) relies less on symbolic gestures and uses more humor and mimicry. On the island of Java, now part of Indonesia, performances of dance-dramas called *wayang wong* exhibit the rigid, jerky quality of puppet theater, from which they developed. Traditional dances on the Indonesian island of Bali are both vigorous and elegant. Balinese dancers perform to the sounds of gongs and flutes.

The dance of China and Japan is less an independent art than part of a total theatrical form that includes singing and spoken drama. Today, the most highly developed form of Chinese dance-drama is the *Beijing opera,* also called the *Peking opera,* which is famous especially for its acrobatics. Japanese *no* theater is an old, traditional art that emphasizes exquisitely restrained and refined dance elements. *Kabuki,* another form of traditional Japanese dance-drama, is livelier and appeals to a wider audience. For more information on Chinese and Japanese dance-drama, see **Drama** (Asian drama).

European and American theatrical dance. In contrast to Asian dance, European and American theatrical dance emphasizes the lower rather than the upper body, and energetic movement rather than precise gesture. Asian dancers communicate with their hands and face, but European and American dancers emphasize their legs and feet. European and American dancers perform leaps and movements in which male dancers lift female partners into the air. In European and American dance, the body does not tell a detailed story as much as it expresses emotions through movement, whether slow and tender, sharp and angry, or large and bold.

Unlike Asian dance, European and American dance is *secular*—that is, it deals primarily with nonreligious themes. European and American dance explores the earthly rather than the divine. Its most common theme is romantic love, but it also expresses ideas about the natural world, family and community life, and social and political issues. During the 1900's, dance became a powerful artistic means for portraying the experiences of the isolated individual within modern society.

Ballet is the oldest and most highly developed form of European theatrical dance, growing out of court dances of the 1400's and 1500's. Ballet dances were later replaced by ballroom dancing as a form of social dance. In addition to performing ballets themselves, by the 1600's court aristocracy employed professional dancers to perform the ballets as staged entertainment. Academies were established to train these professional performers and encourage the development of their art.

By the late 1800's, ballet had reached a high level of refinement. Ballet companies had become expensive organizations that produced great spectacles. Ballets used elaborate scenery and costumes to help tell romantic, fairy-tale stories. For more information on the techniques and history of ballet, see the **Ballet** article.

Modern dance arose as a reaction to the ballet of the late 1800's, with its rigid organization and heavy use of scenic effects. About 1900, a young American woman named Isadora Duncan became well known for performing a kind of dance that seemed to reject everything in ballet. Duncan danced barefoot in a loosely flowing tunic. She usually danced alone, using natural movements rather than the traditional movements of ballet. Duncan began the modern dance emphasis on individuality and innovation. She called her style of movement "the dance of the future," but it became best known as *modern dance*. Duncan's supporters applauded her work as remarkably fresh and spontaneous.

Several American women continued Duncan's innovations. These dancer-teacher-choreographers included Ruth St. Denis, Doris Humphrey, and Martha Graham. Their revolutionary work was even more impressive because it came during the early 1900's, at a time when most women had little voice in society. Women artists were scarce in other art forms, and women dancers in ballet had been limited to performing rather than doing choreography.

Martha Graham became the central figure in modern dance in the mid-1900's. Through her artistry, passion, and intensity, Graham brought modern dance to the level of great art. She developed a method of movement, inspired by the act of breathing, which was based on the contraction and release of muscles. The method was designed to capture the rhythm of human emotion. Graham's method became the standard modern dance technique adopted throughout the world.

Graham created nearly 200 dances, the best revealing tremendous dramatic qualities. She was unsurpassed at translating psychological conflict and spiritual yearning into movement of startling directness and power.

Martha Graham's greatest male dancer was Merce Cunningham, who became her most important successor. Cunningham was an innovator in his dance creations. His dances were an element separate from the music that accompanied them. The dances consisted of sections that were put together in any order.

Modern dance has explored a vast array of creative themes and techniques since the 1950's due to the work of Graham, Cunningham, Doris Humphrey's follower José Limón, and such younger choreographers as Paul Taylor, Twyla Tharp, and Mark Morris. Taylor's work was noted for its inventiveness and humor. Tharp brought modern dance into contact with both social dance and ballet. Morris gained praise for his witty and passionate work distinguished for its musicality, its ele-

Shooting Star

American musical comedy has attracted some of the most creative choreographers of the 1900's. From 1955 to 1978, American director and choreographer Bob Fosse was a dominant choreographer on Broadway. He created several acclaimed dances for the 1966 musical *Sweet Charity*. In 1969, Fosse also directed the motion-picture version that starred Shirley MacLaine, *center*.

gant simplicity, and its warmly human quality.

African Americans made important contributions to modern dance. Alvin Ailey was a major figure. In creating his American Dance Theater, Ailey sought to make modern dance into a vehicle for expressing the black experience through music and movement. His company gained praise for its exuberance and energy.

Modern dance flourished not only in the United States but in European countries as well, especially Germany, Belgium, and the Netherlands. Mary Wigman led the modern dance movement in Germany during the 1920's and 1930's. The leading modern dance choreographers at the end of the 1900's included Pina Bausch of Germany and Jiří Kylián of the Czech Republic, who worked in the Netherlands.

Many younger choreographers of the late 1900's turned away from modern dance as an art that consisted purely of movement. Their work mixed and often emphasized video, spoken language, and other nondance elements.

Musical comedy is a primarily American form of theatrical entertainment that typically tells a story through songs and dialogue as well as dance. Musicals generally feature athletic, rhythmic dancing, but some also include dance pieces that resemble classical ballet. Important ballet choreographers who have created dances for musical comedies include George Balanchine, Agnes de Mille, and Jerome Robbins. Some of the best American musicals are known primarily for their dances, such as Robbins's *West Side Story* (1957); *A Chorus Line* (1975), with choreography by Michael Bennett; *Chicago* (1975), with choreography by Bob Fosse; *My One and Only* (1983), with choreography by Tommy Tune; and *Crazy for You* (1992), with choreography by Susan Stroman.

Other forms of theatrical dance include jazz dance and tap dancing. Both are major elements of dance in musical comedies and in motion pictures.

Jazz dance, like jazz music, relies strongly on rhythm. It is usually energetic, with dancers using different parts of the body, such as the shoulders, pelvis, and head, in isolated movement. Jazz dancing is a personal style that emphasizes individual expression and often includes humor and improvisation.

Tap dancing combines dance traditions from Britain and Africa. It resembles jazz dancing in its strong rhythms and frequent displays of improvisation. Tap dancing relies almost totally on footwork, however. The feet become musical instruments, marking out complex rhythms with the heel and toe. Tap dancing underwent a revival during the 1990's, largely due to the work of such young dancers and choreographers as Gregory Hines and Savion Glover. William Deresiewicz

Related articles in *World Book* include:

Biographies

For biographies of ballet dancers and choreographers, see the *Related articles* in the **Ballet** article. See also:

Ailey, Alvin
Astaire, Fred
Cunningham, Merce
Duncan, Isadora
Dunham, Katherine
Graham, Martha
Holm, Hanya
Kelly, Gene
Nikolais, Alwin
Robinson, Bill
Rogers, Ginger
Saint Denis, Ruth
Shawn, Ted
Taylor, Paul
Tharp, Twyla

Kinds of dances

Ballet
Ballroom dancing
Bolero
Cotillion
Flamenco
Folk dancing
Fox trot
Minuet
Rumba
Square dancing
Tango
Tarantella
Waltz

Pictures of dancers

The following articles have pictures of dancers:

Africa
Asia
Clothing
Folklore
France
Gypsies
Indian, American
Indonesia
Kenya
Latin America
Mexico
Motion picture
Pacific Islands
Pygmies
Roaring Twenties
Romania
South Dakota
Spain
United States

Other related articles

Band (Dance bands)
Buffalo ceremonials
Castanets
Ghost dance
Hawaii (Dancing and music)
Mask
Musical comedy
Pantomime
Rain dance
Rhythm
Rock music (Disco and punk)
Snake dance
Sun dance

Outline

I. Why people dance
- A. Religious reasons
- B. Social reasons
- C. Recreational reasons
- D. Artistic reasons

II. Dances to take part in
- A. Ritual ethnic dances
- B. Folk dances
- C. Social dances

III. Dances to watch
- A. Asian theatrical dance
- B. European and American theatrical dance

Questions

What are some features of tribal dance?
What is a *mudra?*
Who was Isadora Duncan? Martha Graham?
What are the four major forms of Indian dance?
What is the significance of a *Maypole dance?*
What are some reasons why people dance?
What are the main characteristics of jazz dance?
How do participatory or communal dances differ from theatrical dances?
What role does religion play in Asian theatrical dance?
What are some of the chief functions that dance serves in society?

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Dancesport. See Ballroom dancing.

WORLD BOOK illustration by Lorraine Epstein

The dandelion is a yellow wild flower.

Dandelion is a bright-yellow wild flower that grows in lawns and meadows. Throughout the temperate regions of the world, gardeners usually consider the dandelion a troublesome weed that is difficult to control.

The early colonists brought the dandelion to America from Europe. Its name comes from the French words *dent de lion,* meaning *lion's tooth.* It has smooth leaves with coarse notches, which look like teeth. The golden-yellow head is really a cluster of flowers. The flowers, when they mature, form feathered, cottony seeds that the wind carries far and wide. The dandelion has a smooth, straight, and hollow stem, and the entire plant contains a white, milky juice. The root is long, thick, and pointed and has hairlike branches growing from it.

The dandelion differs from most other plants in the way it reproduces. Its ovaries form fertile seeds without having to be pollinated (see **Pollen**).

Young dandelion leaves can be used in salads or they can be cooked. They taste best when they are young, before the plant has blossomed. Wine sometimes is made from the dandelion flowers.

In order to keep dandelion plants from growing on lawns, gardeners must cut deep into their roots. The roots grow to about 3 feet (91 centimeters) long in soft, rich earth. Slicing close under the surface only encourages the plants to grow. Gardeners sometimes spray dandelions with chemicals that destroy the dandelions but do not harm grass.

Scientific classification. The dandelion is a member of the composite family, Compositae. The scientific name for the common dandelion is *Taraxacum officinale.* Anton A. Reznicek

Dandie Dinmont terrier is a dog that got its name from a book. In Sir Walter Scott's novel *Guy Mannering,* a farmer named Dandie Dinmont raised an unusual pack of short-legged terriers that were all the color of pepper or mustard. In the book, the dogs were famous as hunters of foxes, badgers, and otters. A new breed was later called Dandie Dinmont for the farmer in the book.

The Dandie Dinmont terrier has a big head and large, soft brown eyes. Its forehead is covered by a silky *topknot* (tuft of hair). Its coat is crisp to the touch on the back and soft and downy underneath. Dandies weigh from 18 to 24 pounds (8 to 11 kilograms) and stand 8 to 11 inches (20 to 28 centimeters) high at the shoulder. See also **Dog** (picture: Terriers).

Roy and Betty-Anne Stenmark (Fox & Cook Photography)

The Dandie Dinmont terrier has short front legs.

Critically reviewed by the Dandie Dinmont Terrier Club of America

Dandruff is a condition in which flakes of dead skin are shed from the scalp. The flakes may be yellow and oily, or white and dry. The scalp normally sheds some dead skin cells. Dandruff results when it sheds thick layers of them. Physicians do not fully understand what causes the condition, and most people have it at some time. In most cases, mild dandruff can be controlled by washing the hair frequently. Dandruff does not cause baldness.

A condition called *seborrhea* may produce severe dandruff and a red, itchy scalp. Dandruff shampoos help treat the problem. If the condition continues, a physician should be consulted. Orville J. Stone

Danes. See **Denmark; England** (The Anglo-Saxon period).

Daniel, Book of, is a book of the Bible. It is named for a Jewish hero who lived in Babylon from the end of the 600's B.C. to the late 500's B.C. In Jewish forms of the Bible, the book is part of a collection called the *Writings.* Christian editions include it in a group called the *Prophets.* The Book of Daniel is divided into two parts. Chapters 1-6 contain six stories that deal with historical events over a period of almost 50 years in Babylon and emphasize Daniel's loyalty to his faith. Chapters 7-12 include stories of four visions. In these visions, Daniel describes four empires that will rule the world until the triumph of God's kingdom.

In one famous story in the book (6: 1-28), Daniel is thrown into a den of lions for refusing to worship Darius the Mede as a god. The animals refuse to harm Daniel. Another story tells how Daniel interpreted mysterious handwriting that appeared during a feast held by the Babylonian ruler Belshazzar (5: 1-31). In chapter 3: 1-30, Daniel's companions Shadrach, Meshach, and Abednego are cast into a fiery furnace because they refuse to worship a golden idol. The flames do not hurt them.

Biblical scholars do not agree on the date of the book. Some once believed that Daniel was the author. Today, scholars believe the book was written much later. Many think it was written during the 100's B.C. These scholars say the author wanted to use Daniel as a heroic model to encourage Jews in a revolt against the Seleucid king

Daniel in the Lions' Den was painted by the Flemish artist Peter Paul Rubens. The picture shows Daniel praying at dawn after safely spending the night in the lions' den. Completed about 1615, it is one of the few large works Rubens painted without assistants.

Oil painting on canvas; National Gallery of Art, Washington, D.C., Ailsa Mellon Bruce Fund

Antiochus IV. The revolt was led by Judah Maccabee in the 160's B.C. Eric M. Meyers

See also **Bible** (Books of the Hebrew Bible); **Handwriting on the wall.**

Daniel-Rops, *da NYEHL ruhps,* **Henri,** *ahn REE* (1901-1965), was the pen name of Henri-Jules Periot, a French author and religious historian. He gained his greatest recognition for *Jesus in His Times* (1945), a brief history of the life of Jesus Christ. His 10-volume *History of the Church of Christ* (1948-1965) traces the history of the Christian church. Daniel-Rops was born in Épinal. In the 1920's and 1930's, he wrote novels and essays that radiated religious devotion and concern for humanity's loss of genuine religion. During World War II, the Nazis tried to destroy his *Sacred History* (1943), a history of the Jews. But a few copies survived, and the book was later reissued. In 1955, Daniel-Rops was elected to the French Academy. Roland N. Stromberg

Dannay, Frederic. See **Queen, Ellery.**

D'Annunzio, *duh NUN see oh,* **Gabriele,** *GAH bree EH lee* (1863-1938), was an Italian author and political figure. His poetry deals with nature, the sea, and his own desire for passionate experiences. The poems show an unusual sensitivity for colors, moods, and feelings. His style is imaginative and melodious, but often flowery. His best poetry is contained in the collection *Alcyone* (1904). D'Annunzio wrote many novels, several based on his scandalous personal life. *The Flame of Life* (1900) is based on his love affair with actress Eleonora Duse (see **Duse, Eleonora**). His plays include *La Gioconda* (1898) and *The Daughter of Jorio* (1904).

D'Annunzio was born in Pescara. In 1910, his extravagant living forced him to declare bankruptcy, and he moved to Paris. He returned to Italy to campaign for his country's entry into World War I. In 1919 and 1920, he served as the self-appointed ruler of the city of Fiume (now Rijeka, Croatia) after seizing the city with a military force. Richard H. Lansing

Dante Alighieri, *DAHN tay ah lee GYA ree* (1265-1321), an Italian author, was one of the greatest poets of the Middle Ages. His epic poem *The Divine Comedy* ranks among the finest works of world literature. Critics have praised it not only as magnificent poetry, but also for its wisdom and scholarly learning.

Dante was a great thinker and one of the most learned writers of all time. Many scholars consider *The Divine Comedy* a summary of medieval thought. Dante had a tremendous influence on later writers. Geoffrey Chaucer and John Milton imitated his works. Dante influenced such writers as Henry Wadsworth Longfellow, Percy Bysshe Shelley, Lord Byron, Lord Tennyson, Victor Hugo, Friedrich Schlegel, and T. S. Eliot.

His life. Dante was born in Florence. He received a rich education in classical and religious subjects. He may have studied at Bologna, Padua, and possibly Paris.

Dante's idealized love for a beautiful girl, Beatrice Portinari (1266-1290), provided much inspiration for his literary works. He saw her only twice, once when he was almost 9 and again nine years later. Her death at a young age left him grief-stricken. Sometime before 1294, Dante married Gemma Donati. They had at least three children.

Dante was active in the political and military life of Florence. He entered the army as a youth and held several important positions in the Florentine government during the 1290's. Dante became involved in a political dispute between two groups, the Guelphs and the Ghibellines, who were fighting for control of Tuscany. A political group within the Guelphs gained control of Florence in 1301. This political group was hostile to the poet and banished him in 1302, condemning him to death if he returned to Florence. Dante spent the rest of his life in exile and died in Ravenna, where he was buried.

His works. Among Dante's early writings, the best known is *La Vita Nuova* (*The New Life*), written about 1293. It is a collection of 31 poems with prose commentary describing his love for Beatrice. *The New Life* shows the influence of troubadour poetry, a style that flourished in southern France in the 1100's and 1200's.

Dante began *The Divine Comedy* about 1308. The poem relates his spiritual development and focuses on

the theme of life after death. For more information about this work, see **Divine Comedy.**

Dante also wrote several nonfiction works. About 1303 and 1304 he wrote *De Vulgari Eloquentia (On Eloquence in the Vernacular).* This work in Latin prose stresses the importance of writing in a common Italian language, rather than in Latin or a minor dialect. Dante hoped that the Italians would develop a national literary language to help unite the country.

Il Convivio (The Banquet, 1304-1307) is an unfinished work written in Italian, consisting of three odes, each followed by long, detailed commentaries on their meaning. The work is filled with Dante's wide knowledge of philosophy and science. *The Monarchia (On World-Government,* 1313?) is a long essay in Latin prose. Dante called for the state, in the form of the Holy Roman Empire, to join with the church in guiding people to a better life on earth and joy in heaven. Other works include a group of poems and several letters. Richard H. Lansing

See also **Allegory; Virgil** (His influence).

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Danton, *dahn TOHN* or *DAN tuhn,* **Georges-Jacques,** *zhawrzh zhahk* (1759-1794), was a great leader of the French Revolution. He helped turn the government of France from a monarchy into a republic and was also partly responsible for the Reign of Terror. During this period of the revolution, many people who publicly disagreed with official policy were executed. Danton himself became a victim of the violence.

Danton was born of middle-class parents on Oct. 26, 1759, in Arcis-sur-Aube, France, near Troyes. He became a lawyer and a leader of the Cordeliers Club, one of the most radical political societies in revolutionary Paris. After King Louis XVI made an unsuccessful attempt to flee France in June 1791, the club demanded that Louis be deposed. On Aug. 10, 1792, this goal was achieved when a public uprising drove the king from his throne.

After the uprising, Danton was France's most powerful national leader. With enemy armies of Austria and Prussia approaching Paris to restore the monarchy, he stirred people to action, declaring, "Boldness, more boldness, and still more boldness, and France will be saved!" In September 1792, Danton was elected to France's new legislature, the National Convention, which immediately declared France a republic. Along with Maximilien Robespierre, Danton became a leader of the radical political group known as the Mountain. Danton called for extreme measures to control opposition to the revolution and supported an emergency government headed by the Committee of Public Safety. This committee and the National Convention established the stifling laws that began the Reign of Terror.

By the end of 1793, Danton believed the need for such bloody measures had passed. He felt the Convention should relax its rule and end most political executions. Robespierre opposed this easing of policy. Fearing that Danton's popularity would weaken the authority of the revolutionary government, the Committee of Public Safety ordered his arrest. The Revolutionary Tribunal, a court that Danton had helped create, ignored his eloquent defense and condemned him to death. Danton was guillotined on April 5, 1794. Isser Woloch

See **French Revolution; Marat, Jean-Paul; Robespierre.**

Danube River, *DAN yoob,* is the second longest river in Europe. Only the Volga River is longer. The Danube flows 1,770 miles (2,850 kilometers) from southern Germany to eastern Europe. The river drains about 315,000 square miles (815,800 square kilometers) of land. It has the largest volume of flow of any European river.

The Danube begins at the merger of two small rivers in the Black Forest in Germany. It winds east through Germany and Austria and along part of the border between Slovakia and Hungary. The Danube curves south near Budapest, Hungary. It flows through Hungary, forming part of the border between Croatia and Yugoslavia. It turns east and flows across Yugoslavia, then forms part of the border between Yugoslavia and Romania and most of the border between Romania and Bulgaria. It flows north through Romania and splits into three branches before emptying into the Black Sea.

Commercial ships and barges transport large amounts of freight on the Danube. They carry agricultural goods, chemicals, mineral ores, steel, and other products. About 35 major ports lie along the Danube.

Several countries have dams and electric power plants on the Danube. The largest dam is the Iron Gate Dam. It stands at the Iron Gate, a gorge at the border between Yugoslavia and Romania. The power plant of the dam produces electric power for Romania and Yugoslavia. The Danube has become extremely polluted with chemicals and raw sewage. Many canals connect

WORLD BOOK map

Location of the Danube River

the Danube to other waterways. The Main-Danube Canal, which connects the Danube to the Main River—a branch of the Rhine—was completed in September 1992. This canal makes it possible for ships to travel between the Black and North seas. Warren E. Yasso

Danzig. See Gdańsk.

Daoism. See Taoism.

Daphne, *DAF nee,* was a nymph in Greek mythology. She was the daughter of a river god, either Ladon or Peneus. The best-known myth about Daphne tells of her

flight from the god Apollo. The god Eros shot both Daphne and Apollo with arrows in revenge against Apollo for insulting his skill as an archer. Eros shot Apollo with a gold-tipped arrow, causing him to fall madly in love with Daphne. He shot the nymph with a leaden one, making her hate all suitors. Apollo pursued Daphne relentlessly. One day, when he was finally about to catch her, Daphne prayed for escape and was transformed into a laurel tree. Although Apollo could not possess her, he made the laurel his sacred tree and wore a crown of laurel leaves on his head. See **Apollo; Cupid.**

Nancy Felson

Dapsang. See K2.

Dar es Salaam, *DAHR ehs suh LAHM* (pop. 870,020), is the capital and largest city of Tanzania, and a chief seaport in eastern Africa. The city lies on the east coast of Tanzania. For location, see **Tanzania** (map).

Dar es Salaam is a major transportation center. It has an international airport and a port, and railroads and highways link it with the rest of Tanzania. The city also has many churches, libraries, and research centers. The University of Dar es Salaam, the National Art Gallery, and the National Museum of Tanzania are in the city.

Foreign trade plays a key role in the economy of Dar es Salaam. Large quantities of imported and exported goods pass through the city's port. Products manufactured in Dar es Salaam include cigarettes, footwear, furniture, soft drinks, and textiles.

The sultan of Zanzibar, the ruler of a nearby island, founded Dar es Salaam in 1862 as a trading post. Germany took control of the city in 1887 and made it a major trading center for eastern Africa. British forces captured the city in 1916, during World War I. It became the capital of the United Kingdom's Tanganyika Territory in 1919. Tanganyika gained independence from the British in 1961 and became part of Tanzania in 1964.

Since 1964, the population of Dar es Salaam has risen from about 150,000 to about 870,000. In 1973, Tanzanians voted to move the capital from Dar es Salaam to the inland city of Dodoma. The move was expected to be completed by 2005. Stephen K. Commins

See also **Tanzania** (picture).

Dardanelles, *DAHR duh NEHLZ,* is a strait that joins the Aegean Sea with the Sea of Marmara. The strait is part of a waterway that leads from the landlocked Black Sea to the Mediterranean. Also part of this waterway is the Bosporus, a strait joining the Black Sea and the Sea of Marmara. The word *Dardanelles* comes from the ancient Greek city of Dardanus, on Asia's side of the strait. The ancient Greeks called this strait the *Hellespont.*

At its narrowest point, the Dardanelles is about 1 mile (1.6 kilometers) wide from the European shore to the Asiatic. The average width of the strait is 3 to 4 miles (5 to 6 kilometers). It is about 38 miles (60 kilometers) long, and the average depth is 200 feet (60 meters). It usually has a strong surface current in the direction of the Aegean Sea, but a powerful undercurrent flows east and carries salty water through the Sea of Marmara and the Bosporus into the Black Sea. This undercurrent keeps the Black Sea from becoming a freshwater body.

In 480 B.C., Xerxes I of Persia built a bridge of boats across the Dardanelles near Abydos and led an army over it to invade Europe. In 334 B.C., the Macedonian king Alexander the Great led his army over the Dardanelles into Asia. Hundreds of years later, the strait was important to the defense of the Byzantine Empire. After that empire fell, the Ottoman Empire ruled the Dardanelles. See **Byzantine Empire.**

WORLD BOOK map

The Dardanelles lies between Europe and Asia.

In 1841, the great powers of Europe—Britain, France, Prussia, and Austria—agreed to give Turkey control of the passage of ships through the Dardanelles. This agreement was renewed in 1856, 1871, and 1878. During World War I (1914-1918), several battles were fought over control of the Dardanelles. The Treaty of Lausanne in 1923 opened the Dardanelles to all nations. In 1936, the Montreux convention gave Turkey permission to remilitarize the strait.

Early in World War II (1939-1945), the strait was closed to all ships except those with special permission from Turkey. Although the possession of the Dardanelles was threatened during the war, Turkey kept control of this important waterway. After World War II, the Soviet Union unsuccessfully attempted to gain control of the Dardanelles. The Western powers supported Turkey's rights to the strategic strait. John J. Baxevanis

Related articles in *World Book* include:

Aegean Sea	Marmara, Sea of	World War I (The Dardanelles)
Black Sea	Turkey	
Bosporus		

Dare, Virginia (1587- ?), was the first English child born in America. Her parents were Ananias Dare and Eleanor White, two members of a band of 117 colonists who settled on Roanoke Island in 1587. She was born on August 18 and named Virginia in what may have been the first English christening ceremony in America. See also **Lost Colony.** Kathryn Kish Sklar

Darío, Rubén, *dah REE oh, roo BAYN* (1867-1916), was the pen name of Félix Rubén García Sarmiento, one of the most important poets to write in Spanish. Darío was the major figure among Spanish-language authors associated with the literary movement *modernism.*

A collection of verse and prose called *Azul...* (1888) established Darío's reputation. The verse brought a new rhythmic beauty to literary Spanish. Considered even more innovative are the short prose selections, which stress description over narration and sensory appeal over statement. In *Profane Prose* (1896), Darío perfected his poetic technique. The poems feature unusual rhythmic patterns and sound effects, scholarly references, and luxurious settings.

In *Songs of Life and Hope* (1905), Darío retreated from his earlier ornamental, artful poetry and sought a plainer, more down-to-earth form of expression. This collection includes poems about human doubt and sadness and verse of social commentary. In *Wandering Song* (1907), he continued to move toward poetry that responded more directly to common human problems.

Darío was born in Metapa (now Ciudad Darío), Nicaragua. He held several diplomatic posts, including Nicaraguan consul in Paris and minister to Brazil and Spain. Naomi Lindstrom

See also **Latin-American literature** (Modernism).

Darius I, *duh RY uhs* (550?-486 B.C.), ruled the Persian Empire from 522 B.C. until his death. He is often called Darius the Great. Darius extended the Persian Empire, which was based in southwest Asia, eastward into what is now southern Pakistan and westward into southeastern Europe. He tried to conquer Greece, but failed.

Darius seized the Persian throne after King Bardiya of Persia was murdered in 522 B.C. Armies led by Darius put down a rebellion in Egypt in 519 B.C. and conquered Thrace in southeastern Europe about 513 B.C. Later, Persian forces conquered what is now southern Pakistan. Darius efficiently ruled his empire by dividing it into 20 *satrapies* (provinces). The officials he chose to govern the satrapies raised taxes locally for the royal treasuries and provided Darius with soldiers.

During the 490's B.C., Greeks in Asia Minor (now Turkey) rebelled unsuccessfully against Persian rule. In 492 B.C., a Persian attempt to invade Greece failed. In 490 B.C., Darius sent another expedition to conquer Greece. The army landed northeast of Athens on the plain of Marathon. The Greeks, though outnumbered, defeated the Persians (see **Marathon**). Darius died before he could organize another invasion of Greece. His son Xerxes I succeeded him. Jack Martin Balcer

Darius III, *duh RY uhs* (380?-330 B.C.), was the last of the Achaemenid kings of Persia. This family had developed one of the world's greatest empires in western Asia during the 500's B.C. Darius tried to prevent Alexander the Great, the king of Macedonia, from conquering the Persian Empire, but failed.

Ineffective kings and rebellions by provincial governors had weakened the Persian Empire for almost a hundred years when Darius became king in 336 B.C. He tried to reorganize the central government and build a strong army. In 333 B.C., Alexander the Great defeated Darius's forces at Issus in what is now southern Turkey. In 331 B.C., Alexander again defeated Darius in the Battle of Arbela, also called the Battle of Gaugamela, in what is now northern Iraq. Darius was murdered by his own nobles in 330 B.C. Jack Martin Balcer

See also **Alexander the Great.**

Darjiling, *dahr JEE lihng* (pop. 107,530), also spelled Darjeeling, is the summer capital of the state of West Bengal in eastern India. It lies on the lower slopes of the Himalaya, north of Kolkata, about 7,100 feet (2,160 meters) above sea level. The high altitude makes the city cool and pleasant the year around. People who live in the Indian lowlands seek relief from the heat by going to Darjiling in September and October. Mount Everest is visible from just outside the city. The well-known Darjiling tea grows on nearby hillsides. A wide square serves as an open-air bazaar for trading. Robert LaPorte, Jr.

Dark Ages is a term once used to describe the Middle Ages, especially the early Middle Ages, which lasted from the A.D. 400's to the 900's. The term referred to a supposed lack of learning in the period. Actually, the Middle Ages were not completely "dark." The period only seemed dark to scholars of the more advanced Renaissance and to historians influenced by them.

In the early Middle Ages, civilization sank low in Western Europe. Knowledge from ancient Rome survived only in a few monastery, cathedral, and palace schools. Knowledge from ancient Greece almost disappeared. Few people received schooling. Many artistic and technical skills were lost. Population decreased, and economic life became more primitive. Joel T. Rosenthal

For a description of the life and culture of the Dark Ages, see **Middle Ages; Feudalism; Renaissance.**

Dark matter is the invisible substance that makes up most of the mass of the universe. Dark matter is called "invisible" because there is no evidence that it gives off, reflects, or absorbs visible light, radio waves, X rays, or any other kind of electromagnetic energy. Scientists have detected dark matter only through its gravitational effects. Observations suggest that dark matter has at least 30 times as much mass as visible matter has. Scientists do not know the composition of dark matter, but they need to determine it to understand how the universe has evolved.

Evidence of dark matter comes from studies of three kinds of motion: (1) the motion of stars and gas clouds in galaxies, (2) the motion of *satellite galaxies,* relatively small galaxies that rotate around a much larger galaxy, and (3) movements of galaxies in groups called *clusters.* Additional evidence comes from the bending of light from distant galaxies by the gravity of nearer galaxies and clusters. All the studies indicate that the mass of any galaxy is several times larger than the mass of its stars and other visible parts.

Some dark matter may consist of *massive astrophysical compact halo objects* (MACHO's), bodies made of ordinary matter. Observations made with telescopes since 1993 have provided evidence of MACHO's in our home galaxy, the Milky Way. The observations suggest that roughly 20 percent of the dark matter in the Milky Way consists of MACHO's, and that the mass of the individual MACHO's is about half that of the sun.

A once-favored theory suggests that most dark matter consists of subatomic particles called *neutrinos.* Experiments conducted in Japan and Canada indicate that neutrinos have at least a small mass. If the neutrinos' mass turns out to be a significant fraction of the mass of the universe, scientists will have to revise their description of how the galaxies formed.

Galaxies probably developed from huge clumps of dark matter billions of years ago. In the early universe, when galaxies began to form, neutrinos would have been traveling at almost the speed of light—earning neutrinos the description "hot dark matter." The fast motion of the neutrinos would have smoothed out any lumps of neutrino matter that could have developed into galaxies. If neutrinos do have significant mass, then some unknown process must have formed the galaxies.

According to the theory that many astronomers now expect will prove true, most dark matter consists of "cold" particles that moved much more slowly than light

in the early universe. Such particles might be weakly interacting massive particles (WIMP's), whose mass would be much larger than that of a proton. Or they might be axions, which would be much less massive than electrons. In the 1980's and 1990's, scientists showed that the cold dark matter theory predicts the formation of galaxies with roughly the properties seen in actual galaxies.

In the 2000's, scientists used sensors in underground laboratories in Minnesota, France, and Italy to search for WIMP's. Lawrence Livermore National Laboratory in California searched for axion dark matter. Joel R. Primack

See also **Galaxy; Interstellar medium; Matter; Neutrino; Shadow matter.**

Darling, Ding (1876-1962), was an American editorial cartoonist. During the Great Depression of the 1930's, his work often ridiculed the relief programs of President Franklin D. Roosevelt. Darling also took a strong interest in the conservation of natural resources. Many of his cartoons criticize those who threaten wildlife. Darling won the Pulitzer Prize for cartooning in 1924 and 1943.

Jay Norwood Darling was born on Oct. 21, 1876, in Norwood, Michigan, and was nicknamed Ding while a student at Beloit College. He became a cartoonist for the *Sioux City* (Iowa) *Journal* in 1901 and joined the *Des Moines Register* in 1906. From 1917 until his retirement from the *Register* in 1949, the *New York Tribune* (later called the *Herald Tribune*) distributed his cartoons to newspapers across the United States. He died on Feb. 12, 1962. Michael Emery

Darrow, Clarence Seward (1857-1938), was the most famous American lawyer of the early 1900's. He became known worldwide as a brilliant criminal defender.

Darrow was born on April 18, 1857, in Kinsman, Ohio, near Youngstown. He studied law for a year at the University of Michigan and began practicing law in Ohio in the early 1880's. Darrow moved to Chicago in 1887 and later worked as an attorney for the city of Chicago and the Chicago & North Western Railway. Darrow represented Eugene V. Debs and other officials of the American Railway Union who were arrested for supporting the Pullman strike of 1894, which disrupted mail delivery. This case made him famous as a defender of labor.

Darrow became active as a defense attorney for labor unions and served in the Illinois House of Representatives from 1903 to 1905. In 1911, Darrow went to Los Angeles to defend John J. and James B. McNamara. The brothers, both labor leaders, were charged with dynamiting the Los Angeles Times Building. Darrow had the McNamaras plead guilty and saved them from a probable death sentence. But he lost union support forever.

Darrow returned to Chicago and started to specialize in criminal cases. He was nearly 70 years old when he tried his two most spectacular cases. In 1924, he defended Nathan F. Leopold, Jr., and Richard A. Loeb, who admitted kidnapping and murdering 14-year-old Bobby Franks in an attempt to commit a perfect crime. Darrow used psychiatric evidence to argue that the 19-year-old Leopold and 18-year-old Loeb were mentally ill. His goal was to keep them from receiving the death sentence, which he strongly opposed. Leopold and Loeb each received a sentence of life imprisonment plus 99 years.

In 1925, Darrow helped attract widespread attention to the Scopes trial in Dayton, Tennessee. In this case, he defended the right of John T. Scopes to teach the theory of evolution in public school. Darrow died on March 13, 1938. Kevin Tierney

See also **Scopes trial** (picture).

Additional resources

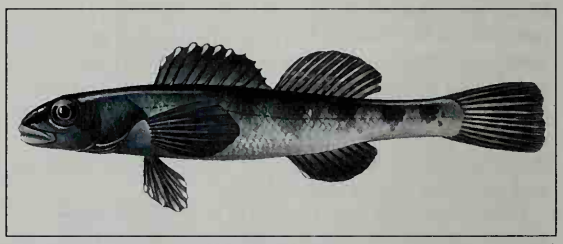
Nardo, Don. *The Scopes Trial.* Lucent Bks., 1996.
Tierney, Kevin. *Darrow: A Biography.* Crowell, 1979.

Dart. See **Blowgun; Darts.**

Darter, a bird. See **Anhinga.**

Darter is any of about 150 species of small freshwater fish belonging to the perch family. Darters are found in North American waters east of the Rocky Mountains, from central Canada to northern Mexico. The fish gets its name from the way it swims, darting quickly from one resting place to another.

Most darters live in clear, fast-moving streams that have gravelly bottoms. Others thrive in lakes and rivers. During the breeding season, male darters of many species develop brilliant colors. Male *rainbow darters,* which become blue, red, and yellow, are especially striking. Female darters lay eggs in spring or early summer. Darters eat a variety of water insects and other fish. The young feed on microscopic organisms called *zooplankton.* Darters range in size from the *least darter,* which measures less than 2 inches (5 centimeters) long, to the *freckled darter* and the *logperch,* which grow nearly 8 inches (20 centimeters) long. Most species measure from 2 to 4 inches (5 to 10 centimeters).



WORLD BOOK illustration by Colin Newman, Linden Artists Ltd.

The Johnny darter is a small fish of the perch family.

Several species of darters have become endangered because the fish are particularly sensitive to changes in their environment. Concern over the *snail darter* delayed completion of the Tellico Dam on the Little Tennessee River during the late 1970's. The dam, which was completed in 1980, destroyed what was then the only known habitat of the snail darter. But the species was later discovered in a few other Tennessee streams and is no longer considered endangered. Henry W. Robison

Scientific classification. Darters are in the freshwater perch family, Percidae. The snail darter is *Percina tanasi.*

See also **Fish** (picture: Fish of temperate fresh waters).

Dartmouth is a community within the Halifax Regional Municipality in Nova Scotia. It lies on the eastern shore of Halifax Harbour (see **Nova Scotia** [political map]). Aerospace companies and two military bases in the area serve as major employers. The community also has an important petroleum refining industry and several smaller industries.

Micmac Indians once used the area as a seasonal campsite. British settlers began to occupy it in 1750. They named their settlement after Dartmouth, England.

Between 1826 and 1860, workers built the Shubenacadie Canal from Dartmouth to the Bay of Fundy on Nova Scotia's west coast. The canal increased commerce in the city. In the 1870's, railroads became commercially more important than the canal.

A harbor explosion in 1917 destroyed much of Dartmouth's industry. Beginning in the early 1940's, the growth of military establishments in the area helped the economy. The construction of a harbor bridge between Dartmouth and Halifax in 1955 and a second one in 1970 drew business.

In 1996, Dartmouth became part of the Regional Municipality of Halifax. The regional municipality combined the cities of Dartmouth and Halifax, the town of Bedford, and the rest of Halifax County under a single regional government. D. A. Sutherland

Dartmouth College is a private coeducational liberal arts school in Hanover, New Hampshire. Associated with it are three graduate schools: Dartmouth Medical School, Thayer School of Engineering, and the Amos Tuck School of Business Administration. Courses lead to bachelor's, master's, and doctor's degrees. Baker Library is one of the largest U.S. college libraries. It is noted for its Stefansson Arctic and Robert Frost collections.

Dartmouth was founded at Hanover in 1769 under a charter granted to Eleazar Wheelock, a Congregational minister, by King George III of England. It developed from Moor's Indian Charity School, founded by Wheelock about 1750 in Lebanon, Connecticut.

Critically reviewed by Dartmouth College

Dartmouth College case, also called *Dartmouth College v. Woodward,* upheld the constitutional freedom from unreasonable government interference with contracts. The Supreme Court of the United States decided this case in 1819. The decision helped protect the rights of private property and encouraged the development of the free enterprise system.

In 1769, King George III of Britain granted Dartmouth College a charter as a private school. This charter was to last "forever." The various states succeeded to the rights and obligations of such charters when they became independent. But in 1816, New Hampshire tried to make Dartmouth College the state university by canceling the charter. Former trustees of the college claimed that the royal charter was still valid. They sued to recover the school seal and records from William H. Woodward, the college secretary. Daniel Webster, a graduate of Dartmouth, presented the trustees' case before the Supreme Court in one of his greatest arguments. The court held for the trustees. It ruled that the state had "impaired the obligation" of the charter in violation of Article I, Section 10 of the Constitution. Because of this case, legislatures today put time limitations in charters or include provisions allowing cancellation under proper circumstances. Jerre S. Williams

Darts is a game in which the players throw darts at a target called a *dartboard.* A regulation dartboard measures about 18 inches (46 centimeters) in diameter. It is divided into 20 equal-sized areas shaped like wedges of a pie. A player scores from 1 to 20 points by hitting different wedges. The board is further divided by a narrow outer ring called the *double ring* and a narrow inner ring called the *triple ring.* A dart that hits one of the rings scores either double or triple the value of the wedge. The *bull's-eye* is worth 25 points. A *double bull's-eye* inside the bull's-eye is worth 50 points.

The dartboard is mounted so the bull's-eye is 5 feet 8 inches (1.73 meters) from the floor. In tournaments, players stand at one of two authorized distances from the board, 7 feet 9 $\frac{1}{4}$ inches (2.37 meters) or 8 feet (2.44 meters). They take turns throwing three darts that measure up to 8 $\frac{1}{4}$ inches (21 centimeters) long. To win, a player must score an exact number of points —in most cases 301, 501, 1001, or 3001. The winner must start and end the game by hitting the double ring or the double bull's-eye. R. Wayne Schmittberger

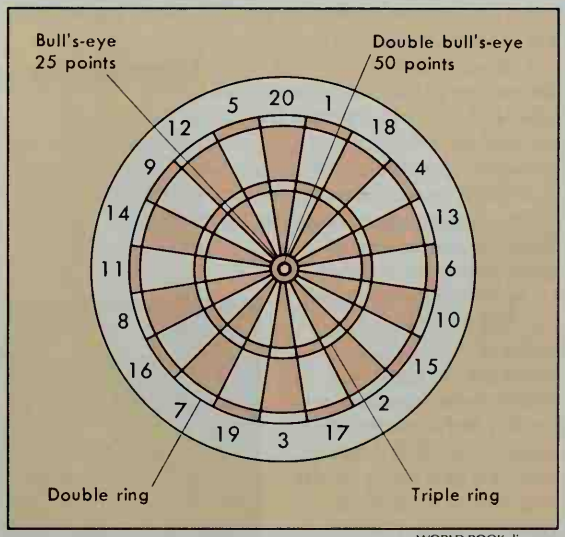
Darwin (pop. 72,622) is the capital and largest city of the Northern Territory of Australia. It lies along Australia's northern coast on the Beagle Gulf, an arm of the Indian Ocean (see **Australia** [political map]).

Darwin is the chief port of the Northern Territory. It is the home of Australian television and radio services that broadcast to Southeast Asia. It has a large military base.

Darwin, originally called Palmerston, was established in 1869. In 1911, the city was renamed in honor of British naturalist Charles Darwin. The city became the first station in Australia on a telegraph line that connected Australia with Europe. In 1974, a cyclone destroyed most of Darwin. The city was rebuilt during the late 1970's. Keith J. Solomon

Darwin, Charles Robert (1809-1882), was a British naturalist who became famous for his theories on evolution. Like several other scientists before him, Darwin believed that, through millions of years, all species of plants and animals had *evolved* (developed gradually) from a few common ancestors.

Darwin's theories included several related ideas. They were: (1) that evolution had occurred; (2) that most evolutionary change was gradual, requiring thousands or millions of years; (3) that the primary mechanism for evolution was a process called natural selection; and (4)



WORLD BOOK diagram

Darts is a game in which the players try to score points by throwing darts at a target. The target is divided into wedge-shaped areas. The wedges are worth from 1 to 20 points. A dart that lands in a ring scores double or triple the wedge's value.

that the millions of species present on earth today arose from a single original life form through a branching process called *speciation,* by which one species can give rise to two or more species. Darwin set forth his theories in his book *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (1859).

Darwin's theories shocked most people of his day, who believed that each species had been created by a separate divine act. His book, which is usually called simply *The Origin of Species,* presented facts that refuted this belief. It caused a revolution in biological science and greatly affected religious thought.

Darwin's life. Darwin was born in Shrewsbury, England. He was the grandson of the noted physician and naturalist Erasmus Darwin, who had proposed a theory of evolution in the 1790's. As a boy, Charles often heard his grandfather's theories discussed.

Darwin studied medicine at the University of Edinburgh and theology at Cambridge University. He received a bachelor's degree from Cambridge in 1831. From 1831 to 1836, Darwin served as a naturalist with a British scientific expedition aboard the H.M.S. *Beagle.* The expedition visited places throughout the world, and he studied plants and animals everywhere it went.

In South America, Darwin found fossils of extinct animals that closely resembled modern species. On the Galapagos Islands in the Pacific Ocean, he noticed many variations among plants and animals of the same general type as those in South America. He collected the fossils and other specimens for future study.

Darwin returned to England in 1836 and settled in London. He spent the rest of his life studying specimens, doing experiments, corresponding with other scientists, and writing about his findings. Darwin's early books included *The Structure and Distribution of Coral Reefs* (1842) and a journal of his research aboard the *Beagle.*

In 1839, Darwin married his cousin Emma Wedgwood. The family moved to Downe, near Croydon, in 1842, and Darwin lived there until his death. He was buried in Westminster Abbey in London.

Darwin's theories. The study of the specimens from the voyage of the *Beagle* convinced Darwin that modern species had evolved from a few earlier ones. He documented the evidence and first presented his theories on evolution to a meeting of scientists in 1858.

In most cases, according to Darwin, no two members of any species are exactly alike. Each organism has an individual combination of traits, and many of these traits are inherited. Darwin claimed that gardeners and farmers commonly developed special kinds of plants and animals by selecting and breeding organisms that had desired traits. He believed a similar selective process took place in nature. Darwin called this process *natural selection,* and others have called it *the survival of the fittest.*

Brown Bros.

Charles R. Darwin

Darwin showed that living things commonly produce many more offspring than are necessary to replace themselves. The earth cannot possibly support all these organisms, and so they must compete for such necessities as food and shelter. Their lives also are threatened by animals that prey on them, by unfavorable weather, and by other environmental conditions.

Darwin suggested that some members of a species have traits that aid them in this struggle for life. Other members have less favorable traits and therefore are less likely to survive or reproduce. On the average, the members with favorable traits live longer and produce more offspring than do the others. They also pass on the favorable traits to their young. The unfavorable traits are eventually eliminated. When this process occurs in two isolated populations of one species, members of one species may become so genetically different that they will be regarded as separate species.

Darwin wrote several books that further discussed his theories of evolution. These included *The Descent of Man and Selection in Relation to Sex* (1871) and *The Expression of the Emotions in Man and Animals* (1872).

The influence of Darwin's ideas. Darwin's theories of evolution through natural selection set off a bitter controversy among biologists, religious leaders, and the general public. Many people thought Darwin had implied that human beings were descended from monkeys, and they angrily criticized his revolutionary ideas. But such noted British scientists as Thomas Henry Huxley and Alfred Russel Wallace supported Darwin's work, and virtually all scientists eventually accepted his theories. These theories, and the facts that supported them, gave biologists new insight into the origin of living things and the relationship among various species.

Darwin's theories stimulated studies in biology, particularly in paleontology and comparative anatomy. During the first half of the 1900's, discoveries in genetics and developmental biology were used as evidence for theories of evolution that regarded natural selection as unimportant. But after World War II ended in 1945, Darwin's theories again became the dominant influence in evolutionary biology in a form often called *Neo-Darwinism.* Neo-Darwinism gave a fuller explanation for the genetic origin of variation within species and for how species are formed. Few biologists reject the basic propositions of Neo-Darwinism, and Darwin's theories are still the basis for many biological studies.

Darwin's work has had a tremendous impact on religious thought. Many people strongly oppose the idea of evolution—and the teaching of it—because it conflicts with their religious beliefs. For example, they claim that the theory of evolution disagrees with the Biblical account of the Creation. Some people argue against the theory of natural selection because they believe it diminishes the role of divine guidance in the universe.

Darwin avoided discussing the theological and sociological aspects of his work, but other writers used his ideas in their own theories about society. The German philosopher Karl Marx compared the struggle for survival among organisms to the struggle for power among social classes. Certain other writers referred to natural selection to justify the concept of the development of superior races of human beings. Scholars called social Darwinists used Darwin's ideas to promote the belief

that people in a society—and societies themselves—must compete for survival. Jerry A. Coyne

See also **Evolution; Heredity** (Early theories about heredity); **Natural selection; Social Darwinism.**

Additional resources

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White, Michael, and Gribbin, John. *Darwin.* 1995. Reprint. Plume, 1997.

Daschle, *DASH uhl,* **Tom** (1947-), who represents South Dakota in the United States Senate, is the Senate majority leader. He is a Democrat known as a political moderate.

Daschle was born on Dec. 9, 1947, in Aberdeen, South Dakota. His full name is Thomas Andrew Daschle. He received a bachelor's degree from South Dakota State University in 1969. From 1969 to 1972, he served in the U.S. Air Force. He then worked as a staff aide to Senator James Abourezk of South Dakota. In 1978, Daschle won election to the U.S. House of Representatives. He served in the House from 1979 to 1987, when he took his Senate seat. He became the Senate Democratic leader in 1995.

In Congress, Daschle became known for defending the interests of American farmers. In 1990, for example, he and other senators from rural areas, called the "prairie populists," led an unsuccessful effort to raise federal price supports for farm products. Daschle also sought money for Vietnam War veterans for illnesses believed to be caused by exposure to a weedkiller known as Agent Orange. The U.S. military had used the chemical in the war. Carroll Doherty

Database is a body of information made up of individual items that are organized so that they can be reviewed in a variety of ways. Many databases are stored on computers and are reviewed by means of programs called *database management systems.* The remainder of this article discusses computerized databases.

Computer users define the sort of data they seek. The management system then instructs the computer to retrieve data that match the definition. A user can also enter items into some databases. The user types the items in boxes that represent various *fields* (categories). With a database program, a person can call up narrowly defined groups of data from storage. The computer displays the data on its screen. Some databases can perform mathematical and desktop publishing tasks.

Major users of databases include libraries that have *online catalogs.* To determine whether a library has a copy of a certain book, an individual can select a field called *title,* then type all or part of the book's title. Other fields in this program might be *author, subject, publisher, catalog number,* and *publication date.* An online catalog may connect many libraries, such as those within a city or county library system.

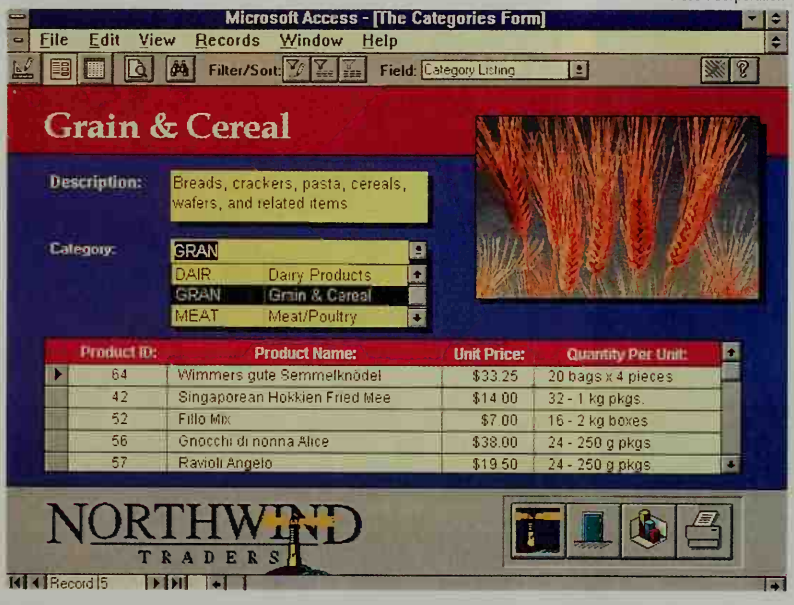
Stores use databases to track customers' purchases and brand preferences. Polling firms use databases to organize statistics on public opinion. Schools may use databases to maintain student records. Other bodies of information managed by database programs include expense records, mailing lists, and tax records.

The information in a computer database is stored in one or more *files.* Each file consists of many *records.* Each record, in turn, contains pieces of information concerning one item. In a library's online catalog, the items are the books. The individual pieces of information are organized into fields. In many database displays, a record runs horizontally across the screen, and fields appear as columns.

A *flat-file database,* such as an online catalog, enables a user to call up data from only one file at a time. A *relational database* can draw data from more than one file. A librarian might use a relational database to search for information on a particular area of study. The database might list individuals or agencies doing research in the field, periodicals that cover the subject area, or books about the subject. Keith Ferrell

See also **Computerized instruction** (Resource programs); **Online service.**

Microsoft Corporation



The database display shown here can be used by a trader to review information about grains and cereals. Five product *records* (sets of data for individual items) run across the lower half of the screen. This information is organized into four *fields* (categories)—product *ID* (identification), product name, unit price, and quantity per unit.

Date Line, International. See International Date Line.

Date palm is the tree that produces dates. Date palms thrive in hot, dry climates. They grow throughout northern Africa and the Middle East, and they flourish in desert oases where few plants can grow. The date palm is one of the oldest crop plants. Early civilizations began to cultivate date palms at least 5,000 years ago. Today, dates still form an important part of the diet in many desert countries.

Uses. Date palms have many uses. They provide nourishment, shade, building materials, and fuel. They are especially important to Muslim peoples of the Middle East. According to Muslim legend, the date palm represents the tree of life.

Dates have a high sugar content, making them rich in carbohydrates. People eat dates fresh or dried. Dried dates can be used in cooking and can be easily stored and preserved. Sugar obtained from the sap of the tree and juice pressed from dates serve as sweeteners. Date mash ferments into an alcoholic drink called *arak,* also spelled *arrack.*

People use the trunk and leaves as building materials. They weave the leaves into baskets, mats, and other articles. Fiber from the bark makes strong rope. Even the pits are burned as fuel or are used as animal feed when ground up.

The tree. Date palms grow as tall as 100 feet (30 meters). They have a straight, rough trunk of about the same thickness from base to top. Featherlike leaves from 10 to 20 feet (3 to 6 meters) long fan out from the top of the trunk. Growths called *suckers* sprout near the base of the trunk and may develop into new plants. For this reason, date palms tend to grow in clumps.

Flowers bloom on the trees between February and June, and the fruit ripens from June to December. Male and female flowers grow on separate trees. Male flowers produce pollen, and female flowers develop into fruit.

The date is an oblong fruit that measures 1 to 2 inches (2.5 to 5 centimeters) in length. Thick, sweet flesh, covered by tough skin, surrounds a single large seed. Dates range in color from yellow to orange, red, or green, depending on the variety.

Dates grow in clusters at the end of stalks. A single cluster on some mature varieties of date palm can hold between 600 and 1,700 dates at time of picking. Date palms bear much fruit. They commonly produce at least 100 pounds (45 kilograms) of fruit annually for about 60 years.

Cultivation and production. Dates require warm temperatures and low humidity to ripen properly. The roots of the date palm need a regular supply of water, such as that provided by irrigation or an underground spring. Date palms may be raised from seeds. But growers more commonly raise them from suckers cut from a parent plant. They plant the suckers in rows about 30 feet (9 meters) apart. Trees begin to flower and bear fruit about four years after planting.

Pollen influences the size, shape, and ripening time of the fruit. Pollination can occur naturally by means of wind. But growers usually pollinate trees by tying a male flower cluster to a female cluster. Paper bags placed above the ripening fruit help prevent damage from rain. Netting or porous cloth placed over the clusters protect the fruit from insects and birds.

Workers harvest the clusters of dates by hand. They treat the dates with carbon bisulfide fumes to kill insects. They then put the dates in a warm place to ripen further and dry. This additional ripening increases the sugar content and reduces acidity.

Growers produce nearly 3 million short tons (2.7 million metric tons) of fresh dates annually. Egypt and Saudi Arabia are the largest producers of dates. Other impor-

© Dan Porges, Peter Arnold

Date palms thrive in hot, dry climates, such as the Middle East, northern Africa, and the deserts of California and Arizona. The date orchard shown above grows in Israel.

© Derek Fell

Clusters of dates that may include as many as 1,700 dates each and weigh up to 25 pounds (11 kilograms) grow on palm trees. The dates have a rich red or golden color while on the tree.

tant producers include Algeria, Iran, Iraq, and Pakistan. In the United States, cultivation occurs primarily in the desert valleys of Arizona and California.

Michael G. Barbour

Scientific classification. The date palm belongs to the palm family, Arecaceae or Palmae. Its scientific name is *Phoenix dactylifera.*

See also **Palm.**

Dating. See **Adolescent; Etiquette; Marriage.**

Datura, *duh TYUR uh,* is the name of a group of poisonous plants that includes jimson weed and angel's trumpet. These large, bushy plants, often called *thorn apple,* have ill-smelling leaves and prickly fruit. The trumpet-shaped flowers range in color from white to lavender. Daturas are native to the tropics, but a few species also now grow in the eastern part of North America. See also **Jimson weed; Nightshade.** Jerry M. Baskin

Scientific classification. Daturas make up a genus in the nightshade family, Solanaceae.

Daudet, *doh DAY,* **Alphonse,** *al FAWNS* (1840-1897), is sometimes called the French Dickens. Like the English author Charles Dickens, Daudet wrote about poor and suffering people and the outcasts of society. Both writers often softened their pictures of the cruelty of reality with a sympathy that occasionally became too sentimental. Daudet had a clear, graceful style. His simple observations of society and his humor and fantasy have made him a favorite with young readers.

Daudet is best known for his humorous short stories in *Letters from My Mill* (1866) and the patriotic stories in *Monday's Tales* (1873). The comic adventures of his boastful character Tartarin appear in two novels, *Tartarin of Tarascon* (1872) and *Tartarin over the Alps* (1895). Daudet also wrote serious realistic novels that contain excellent pictures of his time. These books include *The Nabob* (1877) and *Sapho* (1884).

Daudet was born in Nîmes. His parents were poor, and he was bullied in school by classmates and teachers. He described his unhappy youth in *Little What's Your Name* (1868), his first novel. Thomas H. Goetz

Daugherty, *DAW hur tih,* **James Henry** (1889-1974), was an American artist and author of children's books. He won the 1940 Newbery Medal for *Daniel Boone,* which he wrote and illustrated. Daugherty also wrote and illustrated *Andy and the Lion* (1938), *Poor Richard* (1941), *Abraham Lincoln* (1943), *Of Courage Undaunted* (1951), and *Magna Charta* (1956). Daugherty was born in Asheville, North Carolina. Virginia L. Wolf

Daughters of the American Revolution (DAR) is an organization of women directly descended from people who helped establish American independence. Women over age 18 who can prove such descent are eligible for membership. The DAR's chief goal is to teach and promote good citizenship among American citizens and among immigrants to the United States. Its programs promote appreciation of the past, patriotic service in the present, and educational training for the future. The DAR helps preserve shrines that keep alive the memory of people who won American independence. It encourages the study of American history and maintains relics and records of early America.

The organization owns a boarding school and a day school in remote mountain areas of Alabama and South Carolina. It also aids four other schools and colleges. It

Larry Walker, DAR

Memorial Continental Hall in Washington, D.C., is the original headquarters building of the Daughters of the American Revolution. Its cornerstone was laid in 1904.

publishes a *Manual for Citizenship* to help foreign-born residents of the United States become citizens. The DAR sponsors Junior American Citizens Clubs for schoolchildren, provides scholarships for American Indians, and runs an annual Good Citizens contest in U.S. high schools. The organization's official publication is *The Daughters of the American Revolution Magazine.*

The DAR's official name is the National Society of the Daughters of the American Revolution. The DAR was founded in Washington, D.C., in 1890. It was chartered by Congress in 1896 and must make a report to Congress each year. The DAR has more than 212,000 members in over 3,100 chapters in the United States and other countries.

Headquarters of the DAR consist of three adjoining buildings at 1776 D St. NW, Washington, DC 20006. Memorial Continental Hall houses one of the largest genealogical libraries in the United States. The building also contains 30 State Rooms that are furnished in historic American styles. The Administration Building houses the society's business offices and a museum. Constitution Hall is an auditorium where the society holds its annual Continental Congress, and where many of Washington's cultural events are held. Critically reviewed by the National Society of the Daughters of the American Revolution

Daughters of the Confederacy, United, is an organization of women directly descended from members of the army and navy of the Confederacy. The organization was founded in 1894 at Nashville, Tennessee, by the widows, wives, mothers, and sisters of Confederate fighting men. The original purposes of the group were to honor the memory of the Confederacy and to help needy Confederate soldiers and sailors and their families. The organization has about 27,000 members. There are about 800 chapters in the United States and 1 chapter in Paris, France. The group engages in educational, patriotic, and philanthropic activities, and preserves records and data of the Confederacy. The national office of the United Daughters of the Confederacy is in the Memorial Building to the Women of the South, 328 North Boulevard, Richmond, VA 23220.

Critically reviewed by the United Daughters of the Confederacy

D'Aulaire, *doh LAIR,* is the family name of a husband and wife who wrote and illustrated children's books.

Edgar Parin d'Aulaire (1898-1986) and his wife, Ingri Mortenson d'Aulaire (1904-1980), won the Caldecott Medal in 1940 for their picture-book biography, *Abra-*

ham Lincoln. The couple also won the Regina Medal in 1970. They drew directly on lithographic stone in making their illustrations. Their career as book collaborators began in 1931 with *The Magic Rug.*

Their books include *Ola, Ola and Blakken, Children of the North Lights, Conquest of the Atlantic, George Washington, Benjamin Franklin,* and *Pocahontas.* They also illustrated *The Lord's Prayer, East of the Sun and West of the Moon,* and *Johnny Blossom.*

Edgar was born in Campoblenio, Switzerland, and Ingri in Kongsberg, Norway. They met in Munich, Germany, and were married in 1925. They moved to the United States in 1929. Jill P. May

Daumier, *doh MYAY,* **Honoré,** *aw naw RAY* (1808-1879), was a French artist and one of the most influential social critics of the 1800's. Daumier worked mainly in *lithography* (a type of printmaking), but he also gained recognition for his painting and sculpture. During his life, Daumier was best known for his satirical cartoons and *caricatures* (satirical portraits).

Daumier's works range from light satire to grim realism. Many of his caricatures ridicule middle-class tastes and values. He especially enjoyed attacking doctors and lawyers because he believed they used confusing language and special costumes to conceal their fraudulent practices. An example of his satirical lithographs appears in the article on **Cartoon.**

Daumier often made small clay sculptures to use as models for his lithographs. One of the best examples of these sculptures is *Ratapoil,* a caricature of Emperor Napoleon III. This figure appears in several of Daumier's lithographs as a political troublemaker. Many of Daumier's paintings portray the working-class people of Paris. These works include *The Third Class Carriage* (about 1862) and *The Washerwoman* (1863).

Daumier was born in Marseille and grew up in Paris, where he worked as a lawyer's errand boy. His experiences in the courts and on the streets of Paris gave him insight into the social struggles of the period. While in his 20's, he studied drawing. He later worked as a cartoonist for French political magazines and newspapers. In 1832, he served six months in prison because of a caricature he drew of King Louis Philippe. Richard Shiff

For other examples of Daumier's works, see **Bronze** (picture: Modern French sculpture); **Painting** (What painters paint); **Realism.**

Crispin and Scapin (after 1860), an oil painting on canvas; Louvre, Paris (SCALA/Art Resource)

A Daumier painting shows characters in a comedy by French playwright Molière. The theater inspired many Daumier works.

Dauphin, *DAW fuhn* or *doh FAN,* was the official title from 1349 to 1830 of the oldest son of the king of France. The title was originally used by the lords of Viennois and Auvergne, whose lands in southeastern France were known as Dauphiné. In 1343, Dauphin Humbert II of Viennois, who had no heir, sold King Philip VI the right to rule the land after his death. Humbert sold the right on the condition that one of the royal children would bear the title *dauphin.* Philip gained full control of the land in 1349. At first, the dauphin actually ruled Dauphiné. But the land became part of the kingdom of France in the 1500's and 1600's. The title then became merely an honorary name for the heir to the French throne. See also **Louis XVII.** Donald A. Bailey

D.A.V. See **Disabled American Veterans.**

Davenant, *DAV uh nuhnt,* **Sir William** (1606-1668), was an English playwright. His name is also spelled D'Avenant.

Davenant was born in Oxford. During the 1630's, he wrote elaborate spectacles called *masques* and romantic plays such as *Love and Honour* (1634) and *The Platonic Lovers* (1635). During the civil war and Commonwealth periods in England (1642-1660), when plays were banned, Davenant attempted a new theatrical form, the opera. In 1656, he wrote and produced *The Siege of Rhodes,* generally considered the first English opera.

Davenant supported the Crown during the civil war. After the restoration of Charles II to the English throne in 1660, Davenant became one of two men authorized to reopen the theaters in London. Davenant thus had tremendous influence over theater productions and the careers of playwrights and performers. He oversaw the appearance of the first actresses permitted on the English stage. Albert Wertheim

Davenport (pop. 98,359; met. area pop. 359,062) is the third largest city in Iowa. Only Des Moines and Cedar Rapids have more people. Davenport lies on the Mississippi River in the eastern part of the state (see **Iowa** [political map]). Davenport is the largest city in a metropolitan area commonly called the Quad-Cities. The name Quad-Cities originally referred to what were then the four largest cities of the area—Davenport and the Illinois cities of Rock Island, Moline, and East Moline. As other area cities grew and the population of Bettendorf, Iowa, exceeded that of East Moline, the term came to be used for the entire area. The Quad-Cities is a manufacturing and transportation center surrounded by rich farmland.

Downtown Davenport extends along the riverbank. Large Victorian houses add grace to Davenport's tree-lined streets. The area's main products include aluminum, cement, construction and farm equipment, and processed meats. Marycrest International University, St. Ambrose University, and Palmer College of Chiropractic are in the city.

Until 1832, the site of Davenport was part of an area controlled by the Indian leader Black Hawk. United States Army troops defeated Black Hawk in the Black Hawk War that year. Whites then gained control of the area. Antoine LeClaire, a part-Indian and part-white interpreter, helped found the city. He named it for his friend George Davenport, an English trader. In 1856, the first bridge across the Mississippi River was built at

Davenport by the Chicago and Rock Island Railroad.

Davenport has a mayor-council form of government. It is the seat of Scott County. Mark Ridolfi

David (1030?-965? B.C.) was the second king of Israel and one of the greatest figures in the history of the Jews. He succeeded Saul as king about 1000 B.C. and ruled for approximately 40 years, longer than any other king of ancient Israel.

Marble statue (1504) by Michelangelo; Galleria dell' Accademia, Florence, Italy (Scala/EPA)

David

More chapters of the Bible are devoted to David's reign than to that of any other monarch. The Bible also tells more about David as a person than about any other king. The prophets declared that a descendant of David would become the *Messiah,* an ideal king. This king would bring a golden age of peace, justice, and prosperity to Israel. The New Testament traces the ancestry of Jesus Christ back to David.

The Bible portrays David as a great warrior and as a strong, popular leader. It also tells of his talents as a musician and poet. When David was a youth, his lyre playing endeared him to King Saul. Later, David composed one of his most beautiful and sensitive poems as a tribute to Saul and his son Jonathan after they died in battle. According to tradition, David also wrote many of the Psalms in the Bible (see **Psalms, Book of**).

Early life. David was born in Bethlehem. His father was a shepherd named Jesse. David was the youngest of eight brothers and spent his early years tending his father's sheep. He later became a member of King Saul's court, where he formed a close friendship with Saul's son Jonathan. At that time, the Philistines were Israel's main enemy. The most famous story of David's youth tells of his battle with a Philistine warrior named Goliath. Armed only with a sling and five stones, David killed the giant Goliath.

David's courage and skill in battle quickly made him a hero among the people of Israel. As his popularity grew, however, Saul became extremely jealous of David and tried to kill him. David fled to the area of Israel where the tribe of Judah lived. There he gathered an army of followers. After Saul was killed in battle against the Philistines, David became king of Judah. David ruled Judah for $7\frac{1}{2}$ years and then was named king of all Israel.

King of Israel. During his reign, David established Israel as a major power in western Asia. His troops defeated the Philistines, ending their threat to Israel's security. David also greatly expanded Israel's territory through a series of wars against the Ammonites, Moabites, and other neighboring peoples. He formed an alliance with the Phoenicians, who sent badly needed craftworkers and supplies to Israel.

David was an able ruler and administrator. He united his people and overcame the disunity that had interfered with Saul's reign. David established his capital in Jerusalem, which was centrally located and acceptable to all Israel's tribes. He also made Jerusalem the spiritual center of Israel by having the Ark of the Covenant moved to the city. The Ark was the sacred chest that contained the tablets inscribed with the Ten Commandments.

During the last years of David's reign, his sons plotted and struggled among themselves to determine who would succeed him. David's son Absalom rebelled against him and forced him to flee Jerusalem. David's troops eventually killed Absalom and regained control of the kingdom. However, David mourned bitterly for his son. According to the Bible, these troubles were punishment for a sin. Years earlier, David had committed adultery with a beautiful woman named Bathsheba. David also had Bathsheba's husband killed in battle so he could marry her.

David died about 965 B.C. His son Solomon then became king. Eric M. Meyers

Related articles in *World Book* include:

Goliath
Hittites
Philistines
Saul
Sculpture (picture: *David* by Donatello)
Solomon

Additional resources

Alter, Robert. *The David Story: A Translation with Commentary of 1 and 2 Samuel.* Norton, 1999.
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Detail of a fresco (1509); Scala/Editorial Photocolor Archives

David and Goliath is one of many Biblical scenes painted by Michelangelo on the ceiling of the Sistine Chapel in the Vatican.

David was the name of two kings of Scotland.

David I (1084-1153), the youngest son of Malcolm III Canmore, became king of Scotland in 1124. He invaded England twice, once to support his niece Matilda's claim to the English throne, and again to gain the earldom of Northumbria for his son, Henry. During his reign, David won the support of the many Anglo-Norman barons in Scotland.

David II (1324-1371), the son of Robert Bruce, became king in 1329. David fled to France when England invaded Scotland in 1334. He later fought with France against England in 1346. The English captured him. They released him 11 years later, and he returned to Scotland. Robert S. Hoyt

David, *dah VEED,* **Jacques Louis,** *zhahk lwee* (1748-1825), was the leading French painter during the French Revolution and the Napoleonic era. He painted primarily in the neoclassical style, which emphasizes solidly modeled forms, realistic details, and balanced composition. Neoclassicists often used subjects from ancient history to make observations about contemporary events. David's famous painting *The Oath of the Horatii* (1784) reflects neoclassical style and subject matter.

David was an active participant in the French Revolution and voted for the death of King Louis XVI. He started to depict the events of the revolution in the unfinished *The Oath of the Tennis Court,* begun in 1791. In 1793, he painted *The Death of Marat,* a moving portrait of the assassinated revolutionary leader. An ardent supporter of Napoleon, David also glorified some of the main events of the emperor's life in his paintings.

David was born in Paris. His work influenced many of the major artists of the 1800's, including many members of the impressionist movement. Ann Friedman

Unfinished oil painting on canvas (1800); the Louvre, Paris (Giraudon)

Jacques Louis David's *Portrait of Madame Récamier* emphasizes solidly modeled forms, realistic details, and balanced composition. These qualities are typical of his neoclassical style.

See also **Clothing** (picture: Women's clothing); **French Revolution** (picture: The death of Marat); **Napoleon I** (picture: Napoleon I); **Painting** (The 1600's and 1700's); **Socrates** (picture).

David, Saint (520?–589?), is the patron saint of Wales. Almost no authentic biographical information exists on Saint David. He is said to have founded a number of Welsh monasteries, including St. David's at Mynyw (Menevia) in southwestern Wales. Mynyw is now known as St. David's.

After David's death, a widespread belief grew that he had served as the leader of the Welsh church. Perhaps as a result of this belief, Mynyw became a center of religious authority for much of Wales. In works of art, David is shown standing on a mound with a dove perched on a shoulder. His feast day is March 1. William J. Courtenay

David Copperfield. See **Dickens, Charles** (Dickens' life; The second phase).

Davidson, Jo (1883-1952), an American portrait sculptor, created heads of many famous people. His work is direct and lifelike. His goal was to record the famous men and women of his day. Davidson worked chiefly in terra cotta and bronze. His best-known works include portraits of Mohandas Gandhi and D. H. Lawrence.

Davidson was born in New York City. He studied for three years at the Art Students League there, but then decided on a medical career. While at Yale Medical School, he saw work done by art students in a modeling class and chose to become a sculptor. He went to Paris in 1907 to work and study. Davidson served as a war correspondent during World War I (1914-1918). He lived mostly in France after the war. Joseph F. Lamb

Davies, Arthur Bowen (1862-1928), was an American painter and illustrator. His idealized figures, often taken from literature or legend and represented in a lyrical style, reflect a highly intellectual and poetic personal vision. However, he was keenly aware of the changing artistic ideas of his time. Davies saw value in the more down-to-earth style of painter Robert Henri and his group. He joined Henri's group, known as *The Eight,* or the *Ashcan School* (see **Henri, Robert**). Davies was instrumental in organizing the Armory show of 1913. Held in New York City, this exhibition is generally considered the artistic event that did most to awaken Americans to developments in modern art abroad. Davies was born in Utica, New York. Charles C. Eldredge

Davies, Robertson (1913-1995), was a Canadian novelist, playwright, and journalist. His first three novels—called the Salterton trilogy—are social comedies examining the eccentricities of a small Ontario university town. They are *Tempest-Tost* (1951), *Leaven of Malice* (1954), and *A Mixture of Frailties* (1958). In the three novels known as the Deptford trilogy, Davies explored the relationship between magic, religion, and psychology. These novels are *Fifth Business* (1970), *The Manticore* (1972), and *World of Wonders* (1975). The Cornish trilogy is still more absorbed in Canadian history and exotic lore. These novels are *The Rebel Angels* (1982), *What's Bred in the Bone* (1985), and *The Lyre of Orpheus* (1988). Davies also wrote the novels *Murther & Walking Spirits* (1991) and *The Cunning Man* (1994).

William Robertson Davies was born in Thamesville, Ontario, and was educated in Canada and England. He worked in England as an actor, stage manager, and drama teacher. He later wrote critical studies in drama history and several plays. His best-known plays include *Eros at Breakfast* (1949), *Fortune, My Foe* (1949), and *At My Heart's Core* (1950).

In 1942, Davies became editor of the *Peterborough* (Ontario) *Examiner.* He wrote a syndicated column of witty observations on small-town American and Canadian life. Selections from this column were collected in *The Papers of Samuel Marchbanks* (1985). A collection of Davies's speeches and lectures was published as *One Half of Robertson Davies* (1978). From 1963 to 1981, Davies served as master of Massey College for graduate students at the University of Toronto. Laurie R. Ricou

See also **Canadian literature** (Modern English-Canadian fiction; picture).

Da Vinci, Leonardo. See Leonardo da Vinci.

Davis, Benjamin Oliver, Jr. (1912-2002), was a United States Air Force officer. In 1959, he became the first black U.S. officer in history to be made a major general. He was promoted to lieutenant general in 1965.

Davis was born on Dec. 18, 1912, in Washington, D.C. His father, Benjamin O. Davis, an Army officer, had become the highest ranking black U.S. officer in 1940, when the Army made him a brigadier general.

U.S. Air Force

Benjamin O. Davis, Jr.

In 1936, the younger Davis graduated from the United States Military Academy. He was a member of the Tuskegee Airmen, a group of African Americans who served in the Army Air Corps during World War II (1939-1945), and he earned the Distinguished Flying Cross. In 1961, Davis became director of Manpower and Organization of the U.S. Air Force. He was made Air Force chief of staff in South Korea in 1965, and commander of the 13th Air Force at Clark Base in the Philippines in 1967. In 1968, he became deputy commander in chief of U.S. Strike Command at MacDill Air Force Base in Tampa, Florida. Davis retired from the Air Force in 1970. He died July 4, 2002. Richard Bardolph

Davis, Bette (1908-1989), was an American motion-picture actress known for her portrayals of strong-willed women. Davis won Academy Awards as best actress for her performances in *Dangerous* (1935) and *Jezebel* (1938). She received eight other Academy Award nominations.

A.S.P. from Tom Stack & Assoc.

Bette Davis

Ruth Elizabeth Davis was born on April 5, 1908, in Lowell, Massachusetts. She appeared in several plays before beginning her film career. Davis made her first film, *Bad Sister,* in 1931. She made 85 movies, including *Of Human Bondage* (1934), *Dark Victory* (1939), *The Letter* (1940), *Now, Voyager* (1942), *The Corn Is Green* (1945), *All About Eve* (1950), and *What Ever Happened to Baby Jane?* (1962). Davis also wrote two autobiographies, *The Lonely Life* (1962) and *This 'n That* (1987). Roger Ebert

Davis, David (1815-1886), an American judge and statesman, helped his close friend Abraham Lincoln obtain the nomination for president in 1860. Lincoln appointed Davis to the Supreme Court of the United States in 1862. Davis was nominated for president by the National Labor Reform Party in 1872, but he withdrew the nomination. He resigned from the Supreme Court in 1877, and was elected to the United States Senate from Illinois as an independent. His election prevented him from serving on the Electoral Commission in the disputed presidential election of 1876. Davis's vote might have elected Democrat Samuel J. Tilden (see **Electoral Commission**). Davis was born on March 9, 1815, in Cecil County, Maryland. Bruce Allen Murphy

Davis, Henry Gassaway (1823-1916), was the Democratic candidate for vice president of the United States in 1904. He and presidential candidate Alton B. Parker lost to President Theodore Roosevelt and Charles W. Fairbanks. Davis, at the age of 80, was the oldest person ever chosen to run for vice president. He served as a United States senator from West Virginia from 1871 to 1883. He was born on Nov. 16, 1823, in Woodstock, Maryland. James S. Olson

Davis, Jefferson (1808-1889), served as president of the Confederate States of America during the Civil War. He has been called the man who "symbolized the solemn convictions and tragic fortunes of millions of men." He was not popular with the people of the South during the war, but he won their respect and affection after the war through his suffering in prison and also through his lifelong defense of the Southern cause.

Davis was a statesman with wide experience. He served in the United States House of Representatives and the Senate, and as a Cabinet member. He also won distinction as a soldier. He was a thoughtful student of the Constitution and of political philosophy.

Early life. Davis was born on June 3, 1808, in Christian (later Todd) County, Kentucky. His father, Sam Davis, was a veteran of the Revolutionary War. His older brother, Joseph, moved to Mississippi and became a successful planter. The Davis family moved there while Jefferson was still an infant, and he grew up in Wilkinson County. He attended the county academy, then entered Transylvania University in Kentucky. At the age of 16, he entered the U.S. Military Academy, and graduated with comparatively low grades in 1828.

Davis's Army career took him to Forts Howard and Crawford on the Wisconsin frontier. He fought in campaigns against the Indians, and took charge of Indian prisoner removal after the Black Hawk War. Davis resigned from the Army in 1835.

Davis's family. In 1835, Davis married Sarah Taylor, daughter of his commander, Colonel Zachary Taylor, who later became a general and president of the United States. Davis took his bride to Mississippi and settled down to live as a cotton planter. But within three months, both he and his wife became ill with fever, and Mrs. Davis died. Davis traveled for a year, while he regained his strength. For several years after his return to his plantation, Brierfield, on the Mississippi River, Davis studied history, economics, political philosophy, and the Constitution of the United States. He managed his plantation successfully and became wealthy.

In 1845, Davis married Varina Howell, whose family lived on The Briars, an estate near Natchez, Mississippi. The couple had six children: Samuel, Margaret Howell Hayes, Jefferson, Joseph, William, and Varina Anne. Varina Anne, nicknamed Winnie, became known as the *Daughter of the Confederacy.*

Mrs. Davis was a brilliant hostess. She did much to advance her husband's political career and ably helped him during the Civil War.

His political career. Davis became interested in politics in 1843, and won a seat as a Democrat in the U.S. House of Representatives in 1845. He resigned from

Congress in June 1846 to become a colonel in a regiment of Mississippi volunteers in the Mexican War. He served under General Zachary Taylor in northern Mexico, and distinguished himself for bravery in the battles of Monterrey and Buena Vista. His deployment of his men in a V shape gave him credit for winning the battle of Buena Vista (see **Mexican War**). During the battle, Davis fought all day with a bullet in his foot.

The governor of Mississippi appointed Davis in 1847 to fill out the term of a United States senator who had died. The next year the state legislature elected him for the rest of the term, and in 1850 for a full term. Henry Clay's famous compromise measures came before the Senate in 1850, and Davis took an active part in opposing them in debate (see **Compromise of 1850**). He believed in a strict interpretation of the Constitution, and loyally supported Senator John C. Calhoun, a Southern states' rights leader (see **Calhoun, John C.**).

Davis believed that Mississippi should not accept the Compromise of 1850, and resigned from the Senate to become the candidate of the States' Rights Democrats for governor. He lost the election, and retired to his plantation in Wilkinson County.

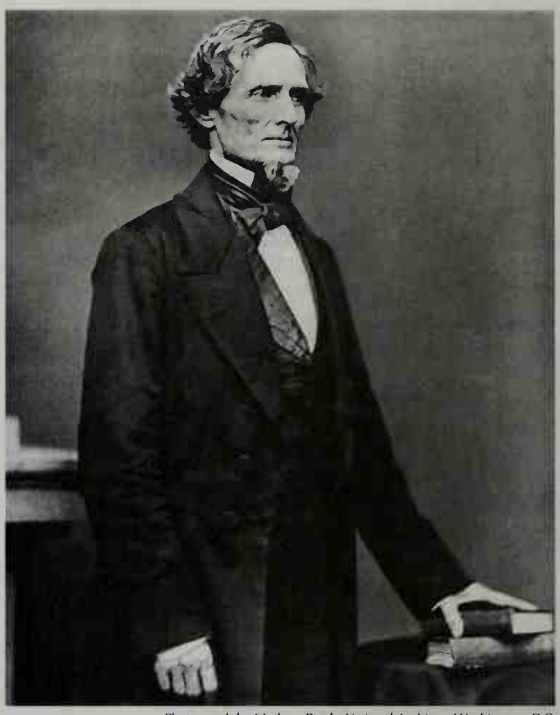
Secretary of war. President Franklin Pierce appointed Davis secretary of war in 1853. Davis improved and enlarged the Army during his term. He introduced an improved system of infantry tactics, and brought in new and better weapons. He organized engineer companies to explore routes for railroads from the Mississippi River to the Pacific Coast. He even tried the experiment of importing camels for Army use in the western deserts. At the close of the Pierce Administration in 1857, Davis was reelected to the Senate from Mississippi. In the Senate, Davis no longer advocated secession, but he defended the rights of the South and slavery. He opposed Stephen A. Douglas' "Freeport Doctrine," which held that the people of a territory could exclude slavery by refusing to protect it. Davis also opposed Douglas' ambition to be the Democratic presidential candidate in 1860 (see **Douglas, Stephen A.**).

Spokesman for the South. Davis became the champion of the constitutional right of a state to choose and maintain its own institutions. He demanded that Congress protect slavery in the territories. In the positions he took, Davis considered himself the heir of Calhoun.

After Abraham Lincoln was elected president of the United States, Mississippi passed an Ordinance of Secession, and Davis resigned from the Senate. Davis hoped to become head of the Army of the Confederate States. But shortly after his return to Mississippi, the convention at Montgomery, Alabama, named him provisional president of the Confederacy. He took the oath of office on Feb. 18, 1861. He was inaugurated as regular president of the Confederacy on Feb. 22, 1862.

Leader of the Confederacy. Davis was probably not the wisest choice for president. His health was poor. Although he was a good administrator, he proved to be a poor planner. He had difficulties with his Congress, and bitter critics condemned his management of the war, charging that he was too watchful of his powers. Some modern historians view Davis as a rigid constitutionalist who was too inflexible in his ideas on command and strategy.

Soon after General Robert E. Lee surrendered, Davis was taken prisoner, and imprisoned at Fort Monroe. A grand jury indicted him for treason, and he was held in prison two years awaiting trial. Horace Greeley and other Northern men became his bondsmen in 1867, and he was released on bail. He was never tried.



Photograph by Mathew Brady. National Archives, Washington, D.C.

Jefferson Davis became the provisional president of the Confederate States of America on Feb. 18, 1861.

His last years. Davis spent his last years writing and studying at "Beauvoir," his home at Biloxi, Mississippi, near the Gulf of Mexico. Davis published *The Rise and Fall of the Confederate Government* in 1881 as a defense against his critics. Davis appeared often at Confederate reunions, and eventually won the admiration of his fellow Southerners. He died on Dec. 6, 1889, and was buried in New Orleans. His body was moved to Richmond in 1893. The state of Mississippi presented a statue of Davis to Statuary Hall in the U.S. Capitol in 1931.

Davis' birthday, June 3, is a legal holiday in seven Southern states. Louisiana celebrates it as Confederate Memorial Day. Kentucky celebrates it as Confederate Memorial Day and as Davis' birthday. Thomas L. Connelly

See also **Civil War; Confederate States of America; Alabama** (picture: Jefferson Davis Home).

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Davis, John (1543-1605), also spelled *Davys*, an English mariner and explorer, was the first European to discover what is now Davis Strait, between Greenland and Canada. He led the way for such explorers of northeast Canada as Henry Hudson and William Baffin. Davis was one

of the most skilled navigators of the late 1500's. He invented a type of *quadrant,* a device used in navigation, and developed what became the standard ship's log.

From 1585 to 1587, Davis headed three expeditions in search of the Northwest Passage, a route through Canada between Europe and Asia (see **Northwest Passage**). He discovered Davis Strait on his first trip. During his voyages, Davis explored the east coast of Baffin Island and the west coast of Greenland but did not find a route west. From 1591 to 1593, he tried to find a passage to Asia via the Strait of Magellan in South America. He failed to do so but sighted the Falkland Islands, off the southeast coast of South America. Davis became a pilot for the East India Company's first fleet to East Asia. He was killed by Japanese pirates. Davis was born at Sandridge Barton in the county of Devon. Barry M. Gough

Davis, John William (1873-1955), a famous American constitutional lawyer, was the unsuccessful Democratic candidate for the presidency of the United States in 1924. He lost to Calvin Coolidge. As a constitutional lawyer, Davis argued 140 cases before the U.S. Supreme Court, more than anyone had argued up to that time. Many considered him the country's most distinguished constitutional lawyer. But he lost his last and most famous case, his Supreme Court defense of South Carolina's public school segregation laws in 1954.

Davis was born in Clarksburg, W. Va. He represented West Virginia in the U.S. House of Representatives from 1911 to 1913. He served as U.S. solicitor general from 1913 to 1918 and as ambassador to Britain from 1918 to 1921. Eric F. Goldman

Davis, Miles (1926-1991), was one of the most influential American jazz trumpeters and bandleaders in jazz history. He became famous for a forceful but lyrical trumpet style. His moody tone and original ideas made him one of the most imitated musicians of his day.

Duncan P. Schiedt

Miles Davis, *right,* was an influential jazz trumpet player from the late 1940's until his death in 1991. During the 1950's, he led an important combo that included alto saxophonist Julian "Cannonball" Adderley, *left,* and bassist Paul Chambers, *center.*

Miles Dewey Davis III was born in Alton, Ill. In 1945, he went to New York City to study music at the Juilliard School. However, he spent most of his time performing with jazz bands, including a quintet led by alto saxophonist Charlie Parker. That group helped create the complex, modern form of jazz known as *bebop* or *bop.* In 1949 and 1950, Davis led a nine-piece ensemble in several recordings that helped develop *cool jazz,* a style that emphasized rich ensemble colors and emotional restraint.

During the 1950's, Davis' bands performed in a more energetic style, though his playing continued to emphasize melody. His major recordings include *Miles Ahead* and *Porgy and Bess,* both arranged for trumpet and orchestra by Gil Evans, and the sextet session *Kind of Blue.* Many musicians gained their first recognition in Davis' bands, including saxophonists John Coltrane and Wayne Shorter; pianists Red Garland, Bill Evans, and Herbie Hancock; bassists Paul Chambers and Ron Carter; and drummers Philly Joe Jones and Tony Williams. Beginning in the late 1960's, Davis pioneered in *fusion,* a movement that combined elements of rock music with jazz. His autobiography, *Miles,* was published in 1989.

Gary Giddins

See also **Jazz** (Cool jazz; New directions).

Davis, Paulina Wright (1813-1876), was an American social reformer. She worked for the right of women to own property and to vote.

In 1840, Davis joined a women's campaign against the property laws of the day. These laws made a man the owner of his wife's possessions. The campaign led to a New York law of 1848 that gave wives control of property they had owned before marriage.

National Portrait Gallery, Smithsonian Institution

Paulina Davis

From 1845 to 1849, Davis lectured to women's groups on the female anatomy. These talks encouraged some of Davis' listeners to join the small number of women who became physicians.

Davis also helped organize the first and second national women's rights conventions. She presided at these meetings, which were held in 1850 and 1851 in Worcester, Mass. From 1853 to 1855, she published a women's rights magazine called *Una.* Davis was born in Bloomfield, N.Y.

Miriam Schneir

Davis, Richard Harding (1864-1916), was an American writer best known as a war correspondent. His exciting, colorful style of reporting earned him a reputation as one of the leading journalists of his time.

Between 1897 and 1916, Davis reported on six major conflicts for New York and London newspapers. He dramatically described events in the Cuban revolution against Spanish rule, the Greco-Turkish War, the Spanish-American War, the Boer War in South Africa, the Russo-Japanese War, and the early years of World War I. His vivid accounts of Lieutenant Colonel Theodore

Roosevelt's Rough Riders during the Spanish-American War helped make Roosevelt famous.

Davis was born on April 18, 1864, in Philadelphia. He began his journalistic career in 1886 with the *Philadelphia Record,* and he served as managing editor of *Harper's Weekly* magazine in the early 1890's. His observations as a war correspondent filled seven books. He also wrote novels, plays, and short stories. William McKeen

Davis, Samuel (1842-1863), a Confederate spy, was called the *Boy Hero of the Confederacy.* Union troops hanged him on Nov. 27, 1863, near Pulaski, Tennessee, because he would not tell who gave him secret military information. Davis's last words were, "I would rather die a thousand deaths than betray a friend or be false to duty." A statue to his memory stands on the Capitol grounds in Nashville, Tennessee. Davis was born on Oct. 6, 1842, near Smyrna, Tennessee. Gabor S. Boritt

Davis, Stuart (1894-1964), was an American painter whose bright, lively paintings deal with everyday life. Davis tried to combine a modern abstract style with American scenes and objects. Bold areas of intense, pure color and rugged written lines mark his work. He often included words from street signs and billboards. Davis's paintings were inspired by jazz, motion pictures, gas stations, storefronts, and mass-produced objects.

Davis was born in Philadelphia on Dec. 7, 1894. At 19, he exhibited in the Armory Show of 1913. The works of Vincent van Gogh, Paul Gauguin, and Henri Matisse impressed him at this exhibition. His mature style also shows the influence of such Cubist painters as Fernand Léger and Pablo Picasso. He did murals for Radio City Music Hall and Rockefeller Center in New York City. Davis died on June 24, 1964. Sarah Burns

Davis Cup is a silver bowl trophy awarded each year to the nation that wins the world's men's tennis championship. Dwight F. Davis, a leading American tennis player, donated the cup in 1900, and competition began that year. The competition consists of a single elimination tournament among 16 qualifying nations. A separate tournament is held for nations that have not qualified. These nations are divided into four zones. The winner of each zone advances to the cup competition for the next year, replacing the nations with the poorest record. See also **Tennis** (Tennis today). Arthur Ashe

Davis Cup tournament

Year	Winner	Runner-up	Score
1900	United States	United Kingdom	3-0
1901	No competition		
1902	U.S.	U.K.	3-2
1903	U.K.	U.S.	4-1
1904	U.K.	Belgium	5-0
1905	U.K.	U.S.	5-0
1906	U.K.	U.S.	5-0
1907	Australia and New Zealand	U.K.	3-2
1908	Australia and N.Z.	U.S.	3-2
1909	Australia and N.Z.	U.S.	5-0
1910	No competition		
1911	Australia and N.Z.	U.S.	5-0
1912	U.K.	Australia and N.Z.	3-2
1913	U.S.	U.K.	3-2
1914	Australia and N.Z.	U.S.	3-2
1915-1918	No competition		
1919	Australia and N.Z.	U.K.	4-1
1920	U.S.	Australia and N.Z.	5-0
1921	U.S.	Japan	5-0
1922	U.S.	Australia and N.Z.	4-1
1923	U.S.	Australia and N.Z.	4-1
1924	U.S.	Australia and N.Z.	5-0
1925	U.S.	France	5-0
1926	U.S.	France	4-1
1927	France	U.S.	3-2
1928	France	U.S.	4-1
1929	France	U.S.	3-2
1930	France	U.S.	4-1
1931	France	U.K.	3-2
1932	France	U.S.	3-2
1933	U.K.	France	3-2
1934	U.K.	U.S.	4-1
1935	U.K.	U.S.	5-0
1936	U.K.	Australia	3-2
1937	U.S.	U.K.	4-1
1938	U.S.	Australia	3-2
1939	Australia	U.S.	3-2
1940-1945	No competition		
1946	U.S.	Australia	5-0
1947	U.S.	Australia	4-1
1948	U.S.	Australia	5-0
1949	U.S.	Australia	4-1
1950	Australia	U.S.	4-1
1951	Australia	U.S.	3-2
1952	Australia	U.S.	4-1
1953	Australia	U.S.	3-2
1954	U.S.	Australia	3-2
1955	Australia	U.S.	5-0
1956	Australia	U.S.	5-0
1957	Australia	U.S.	3-2
1958	U.S.	Australia	3-2
1959	Australia	U.S.	3-2
1960	Australia	Italy	4-1
1961	Australia	Italy	5-0
1962	Australia	Mexico	5-0
1963	U.S.	Australia	3-2
1964	Australia	U.S.	3-2
1965	Australia	Spain	4-1
1966	Australia	India	4-1
1967	Australia	Spain	4-1
1968	U.S.	Australia	4-1
1969	U.S.	Romania	5-0
1970	U.S.	West Germany	5-0
1971	U.S.	Romania	3-2
1972	U.S.	Romania	3-2
1973	Australia	U.S.	5-0
1974	South Africa	India	*
1975	Sweden	Czechoslovakia	3-2
1976	Italy	Chile	4-1
1977	Australia	Italy	3-1†
1978	U.S.	U.K.	4-1
1979	U.S.	Italy	5-0
1980	Czechoslovakia	Italy	4-1
1981	U.S.	Argentina	3-1†
1982	U.S.	France	4-1
1983	Australia	Sweden	3-2
1984	Sweden	U.S.	4-1
1985	Sweden	West Germany	3-2
1986	Australia	Sweden	3-2
1987	Sweden	India	5-0
1988	West Germany	Sweden	4-1
1989	West Germany	Sweden	3-2
1990	U.S.	Australia	3-2
1991	France	U.S.	3-1†
1992	U.S.	Switzerland	3-1†
1993	Germany	Australia	4-1
1994	Sweden	Russia	4-1
1995	U.S.	Russia	3-2
1996	France	Sweden	3-2
1997	Sweden	U.S.	5-0
1998	Sweden	Italy	4-1
1999	Australia	France	3-2
2000	Spain	Australia	3-1†
2001	France	Australia	3-2

Source: United States Tennis Association. *Won by default. †Fifth match suspended by mutual consent.

Davy, Sir Humphry (1778-1829), an English chemist, rose to fame as inventor of the miner's safety lamp. The Davy lamp, perfected in 1815, greatly reduced the risks of coal mine explosions. At the age of 20, Davy experimented with the use of nitrous oxide, or laughing gas, as an anesthetic. At 29, he became the first person to isolate sodium and potassium. He did this by passing an electric current through the fused hydroxides of these elements. He was also first to isolate barium, boron, calcium, magnesium, and strontium.

Davy was born in Penzance, England. In 1802, he became professor of chemistry at the Royal Institution in London. Davy was knighted in 1812 and elected president of the Royal Society in 1820.

Seymour Harold Mauskopf

See also **Aluminum** (History); **Electric arc**; **Safety lamp**; **Chlorine**.

Davy Jones. See **Jones, Davy.**

Davys, John. See **Davis, John.**

Dawes, Charles Gates (1865-1951), a Republican, served as vice president of the United States from 1925 to 1929 under President Calvin Coolidge. He shared the 1925 Nobel Peace Prize for arranging a plan for Germany to pay for damages it caused in World War I (see **Dawes Plan**). Dawes was on the Allied General Purchasing Board during World War I. He became the first director of the federal budget in 1921. From 1929 to 1932, he was ambassador to the United Kingdom. President Herbert Hoover named him president of the Reconstruction Finance Corporation in 1932. He was born in Marietta, Ohio. James S. Olson

See also **Vice President of the U.S.** (picture).

Dawes, William (1745-1799), was an American patriot who helped Paul Revere warn colonists about a British attack at the start of the Revolutionary War. On April 18, 1775, British troops stationed in Boston headed for Concord, Massachusetts, intending to destroy American military supplies there. Patriot leader Joseph Warren first sent Dawes, and later sent Revere, to warn the colonists at Concord and nearby Lexington. The two men, traveling on horseback, were sent separately from Boston by different routes to try to ensure the success of the mission. For a map of their routes, see **Revolutionary War in America** (Clashes at Lexington and Concord). On the night of April 18, Dawes sneaked past a British guard post in Boston. He arrived in Lexington shortly after 12:30 a.m. on the 19th—about a half hour after Revere.

Dawes and Revere left for Concord at about 1:00 a.m. Samuel Prescott joined them as they left. The British soon captured the three men, but Dawes and Prescott escaped. While escaping, Dawes was thrown from his horse, and the horse ran away. Dawes walked back to Lexington. Prescott rode on to Concord.

Dawes was born in Boston. He became a tanner. He may have fought in the Battle of Bunker Hill in June 1775. After the Revolutionary War ended in 1783, Dawes became a prosperous grocer in Boston. James Kirby Martin

See also **Revere, Paul**; **Prescott, Samuel.**

Dawes Act. See **Indian Territory.**

Dawes Plan was a program designed to help Germany pay its World War I *reparations* (payments for damages). The plan resulted from an international conference held in London in 1924. Charles G. Dawes, a banker who later became vice president of the United States, led the committee that formed the plan. In 1921, the Allies had set Germany's debt at $33 billion. The Dawes Plan did not reduce this total, but it did ease Germany's payment schedule. The plan also provided for an international loan to help Germany pay its debt. Germany accepted the plan in 1924. In 1929, the Young Plan replaced the Dawes Plan. But Germany defaulted on its payments during the Great Depression. Robert H. Ferrell

See also **Ruhr** (History).

Dawson, George Mercer (1849-1901), was a Canadian geologist and the son of the geologist Sir John William Dawson. George Dawson joined the Geological Survey of Canada in 1875 and became its director in 1895. The Survey published much of his work, including the first detailed investigations of the geology and natural resources of British Columbia and the Yukon. Dawson also published geographical descriptions of Canada and was coauthor of a study of Indian languages. During the 1870's, he called attention to the rich beds of dinosaur fossils located in Alberta.

Dawson was born in Pictou, Nova Scotia. He attended McGill University in Montreal and the Royal School of Mines in London. Dawson, the former capital of the Yukon Territory, is named for him. Dennis R. Dean

Dawson, Sir John William (1820-1899), was a Canadian geologist and educator. His major work was *Acadian Geology* (first published in 1855), a study of rock formations in Nova Scotia. The book vigorously opposed the theory of naturalist Louis Agassiz that a huge sheet of ice once covered large regions of the Northern Hemisphere. Dawson incorrectly believed that glaciers had covered only small areas of the earth.

Dawson also wrote about coal deposits and the fossils they contain. He discovered important early amphibians and reptiles. In addition, Dawson published on natural history, agriculture, evolution, fossils, and the relationship between science and religion.

Dawson was born in Pictou, Nova Scotia. He served as principal of McGill University in Montreal from 1855 to 1893. In 1882, Dawson became the first president of the Royal Society of Canada. Dennis R. Dean

Day. While the earth travels through space around the sun, it also spins on its own axis. A *solar* day is the length of time that it takes the earth to turn around once with respect to the sun. We usually say *day* for the time when the sun is shining on our part of the earth, and *night* for the time when our part of the earth is dark, or turned away from the sun. But the night is really a part of the whole day. We also say *business day* sometimes to mean the hours of business in any one day.

Each day begins at midnight. In most countries, the day is divided into two parts of 12 hours each. The hours from midnight to noon are the a.m. (before noon) hours. The hours from noon to midnight are the p.m. (afternoon) hours. The military services often designate the time of day on a 24-hour basis, such as 0000 for midnight, 0100 for one o'clock in the morning, 1200 for noon, and 1800 for six o'clock in the evening.

The Babylonians began their day at sunrise. The ancient Jews began the day at sunset. The Egyptians and the Romans were the first to begin the day at midnight.

The length of daylight changes during the year in all parts of the world. It does so because the tilt of the earth's axis causes first one pole to slant toward the sun

and then the other as the planet orbits the sun. The longest day in the Northern Hemisphere usually is June 21 and that in the Southern Hemisphere is December 21. Each of these days has 13 hours and 13 minutes of daylight at 20° latitude. The same days have 14 hours and 30 minutes of daylight at 40° latitude, and 18 hours 30 minutes at 60°. The shortest day in the Northern Hemisphere usually is December 21 and that in the Southern Hemisphere is June 21. Each has only 10 hours and 47 minutes of daylight at 20° latitude, 9 hours 9 minutes at 40°, and 5 hours and 30 minutes at 60°. The length of daylight changes very little during the year at the equator.

When the tilt of the earth's axis causes the North Pole to face the sun, the South Pole is continuously dark and the North Pole is always in daylight. As the North Pole is tilted away from the sun, it becomes dark there while the South Pole has constant daylight. These periods of darkness and daylight last about six months.

Astronomers use a day called a *sidereal day.* It is based on the period of the earth's rotation as measured by fixed stars. This day equals 23 hours 56 minutes 4.091 seconds of mean solar time. James Jespersen

See also articles on the days of the week; **Daylight saving time; Sidereal time; Time; Twilight.**

Day, Benjamin Henry (1810-1889), founded the first successful "penny paper," the *New York Sun,* in 1833. Day priced his little newspaper at one cent a copy, and sent newsboys onto the streets to sell it. This made the *Sun* a novelty in American journalism. Day also attracted readers by emphasizing the human and dramatic element in the news. By 1836, the *Sun* claimed a circulation of 30,000, the largest in the world at the time. Day sold the newspaper in 1838. Day was born on April 10, 1810, in West Springfield, Massachusetts. Joseph P. McKerns

Day, Clarence (1874-1935), was an American writer. He became known chiefly for two books of humorous sketches about his family, *Life with Father* (1935) and *Life with Mother* (published in 1937, after his death). These books were made into *Life with Father* (1939), one of the most popular plays in American theater history. *Life with Father* and *Life with Mother* describe the battle of wits between Day's stern but ineffective father and his slyly rebellious family. Day tells how his mother's illogical reasoning and cunning triumphed over his father in domestic matters. The works provide an entertaining picture of upper-class life in New York City during the late 1800's. Day also wrote essays, stories, and reviews. Day's cartoonlike drawings added humor to his books. Clarence Shepard Day, Jr., was born on Nov. 18, 1874, in New York City. Sarah Blacher Cohen

Day, Dorothy (1897-1980), was an American journalist and cofounder of the Catholic Workers, a Roman Catholic movement that supports social reform and opposes war. She founded the group with French-born philosopher and writer Peter Maurin in 1933. In that year, they began publishing a monthly newspaper, *The Catholic Worker,* to express the movement's goals. The group works to defend the rights of working-class people and to promote peace, charity, and nonviolent social change.

Day was born on Nov. 8, 1897, in New York City. She joined the Socialist Party during her college years and later converted to Roman Catholicism. During the Great Depression of the 1930's, Day and Maurin founded 33 houses of hospitality for poor and homeless people in cities throughout the nation. The houses provided food and shelter for about 5,000 people daily. Day also wrote for several publications, including the socialist newspaper *Call* and the Catholic journal *Commonweal.* Her autobiography, *The Long Loneliness,* was published in 1952. Ed Marciniak

Day, Stockwell (1950-), served as the leader of the Canadian Alliance, a conservative Canadian political party, from July 2000 to December 2001. Day supports smaller government, tax reform, balanced budgets, and reform of Canada's criminal justice system.

Day was born on Aug. 16, 1950, in Barrie, Ontario. He attended the University of Victoria and Northwest Bible College in Edmonton. His work experience before entering politics was varied. It included work on construction sites, as an auctioneer, and as an assistant pastor and administrator of a Christian school.

Day was elected to the Alberta Legislative Assembly in 1986 as a member of the Progressive Conservative Party. He served in a number of posts in the provincial government, including government house leader from 1993 to 1997 and provincial treasurer from 1997 to 2000.

In July 2000, Day was elected to head the newly formed Canadian Alliance. In September, he was elected to the federal House of Commons. He then became the leader of the opposition in the House. He remained in that position following elections in November. In 2001, several Canadian Alliance members criticized Day's leadership and called for his resignation as party leader. As a result, Day stepped down as party leader at the end of 2001. In March 2002, he ran for reelection as party leader but lost to Stephen Harper. David K. Stewart

Day care is a service in which children or dependent adults are cared for while the person who normally cares for them cannot do so. In the United States and Canada, women have traditionally cared for their children and for other dependent relatives. But in recent years, more and more women have begun working outside the home. The number of families with only one parent has also increased. Because of these changes, many families no longer have an adult at home during the day, and the demand for day care has risen.

Types of day care for children. Many working parents enroll their children in a *day-care center.* This is a nonhome site where a group of children receive adult care and supervision. Day-care centers are sometimes called *child-care centers.* Parents may also place their children in a *family day-care home.* In family day care, an adult cares for a small group of children in his or her own home. Usually, this adult is a mother with her own children. Some parents obtain day care by hiring a *sitter* or *nanny.* This is a person who comes to, or lives in, the family home. Other parents rely on relatives to care for their children during the day.

Day care for school-age children. Before- and after-school day-care programs may be located in the school the child attends. Such day care may also occur in a day-care center, a family day-care home, or the home of a relative or neighbor. In many areas, day care for school-age children is hard to find or expensive. For this reason, numerous children care for themselves before or after school.

Government support of day care. Most day-care programs in the United States and Canada are run by in-

dividuals or nongovernment organizations. In the United States, only a few programs are fully funded by state governments or federal agencies. In Canada, many programs are partly or fully funded by the provinces.

Employer-supported day care. In both countries, many employers offer benefits to help working parents care for their children and other dependents. The most common benefits include part-time working hours, flexible schedules, and unpaid leave. Some employers have day-care centers at the workplace. Others help working parents find and pay for day care outside the workplace.

In the United States, companies with 50 or more employees are required by law to offer at least 12 weeks of unpaid leave to employees with a sick family member, a newborn infant, or a recently adopted child. In Canada, federal law allows mothers a 15-week, partially paid maternity leave and a 2-week unpaid leave. In addition, either the mother or the father may take an additional 10 weeks of partially paid leave.

Choosing a day-care provider for children. Experts recommend that parents select a day-care provider that is licensed or regulated by the state or province—if the state or province requires licensing or regulation. Many states and provinces do not regulate or license all types of day-care providers. Experts also suggest that the caregivers have special training in child care and that there be enough of them to provide each child with individual attention. The site should be healthful and safe, activities and equipment should be appropriate to the children's ages, and parents should be able to visit anytime.

Day care for the elderly. Many elderly people are assisted by *home-care aides.* These aides come to the home of elderly adults to help them with personal care and household chores. Some communities have day-care centers for the elderly. Sandra L. Hofferth

Day-Lewis, Cecil (1904-1972), was an Irish-born British poet and novelist. In 1968, Queen Elizabeth II appointed him poet laureate of the United Kingdom.

Day-Lewis was born on April 27, 1904, in Ballintogher, near Sligo, and attended Oxford University. In the 1930's, along with W. H. Auden, Louis MacNeice, and Stephen Spender—all friends from Oxford—he gained fame by writing about political and social forces in a direct, informal, and often deliberately vulgar manner. Much of Day-Lewis's later poetry deals with his Irish heritage and memories of his childhood in Ireland. Day-Lewis's *Collected Poems* were published in 1954. His novels include *The Friendly Tree* (1936) and *Starting Point* (1937). In 1952, he published a verse translation of Virgil's epic poem *Aeneid.* His autobiography, *The Buried Day,* was published in 1960. Day-Lewis wrote detective stories under the pen name of Nicholas Blake. Michael Seidel

Day lily is a type of plant with yellow or orange funnel-shaped flowers, each of which lives only a single day. The plant grows from thick, fleshy roots and produces narrow leaves about 2 feet (60 centimeters) long. The flowers grow in loose clusters at the top of a leafless stalk that may reach 5 feet (150 centimeters) in height. Six to twelve flowers make up a cluster, and two or three open each day. Day lilies are native to Asia and are popular garden plants. They grow under almost all conditions as long as the soil is not too wet and there is some sunlight. They rapidly grow into large clumps that may be divided in late summer or early fall. James S. Miller

Scientific classification. Day lilies make up the genus *Hemerocallis* of the lily family, Liliaceae.

Day of Atonement. See Yom Kippur.

Dayaks, *DY aks,* are a group of people most of whom live in Sarawak, eastern Malaysia. The name is also spelled *Dyaks.* There are two groups of Dayaks—the *Ibans,* also called *Sea Dayaks,* and the *Land Dayaks.* The approximately 350,000 Ibans make up about 31 percent of Sarawak's population. They live along the seacoast and rivers. The 96,000 Land Dayaks compose about 9 percent of the population. They live inland, and they call themselves by the name of their village or locality.

Most Dayaks wear traditional clothing—sarongs for women and *loincloths* (cloth wrapped around the hips) for men. Other Dayaks have adopted Western dress.

Most Dayaks live in bamboo houses built on poles, called *long houses.* The floors are from 6 to 15 feet (1.8 to 4.5 meters) above the ground. Long houses measure from 30 to 1,000 feet (9 to 300 meters) long. Up to 50 families may live in one house, each in a separate room. Most Dayaks are farmers or plantation workers, and their major crop is rice. Some teach school or hold civil service or factory jobs. Others are skilled boat makers or weavers. Most Dayaks follow traditional religions. Some are Christians or Muslims. David P. Chandler

Dayan, *dy AHN,* **Moshe,** *MOY shuh* (1915-1981), was an Israeli military hero and political leader. He commanded the Israeli forces that won the Arab-Israeli war of 1956, and directed the Israeli victory in a six-day war fought against Egypt, Jordan, and Syria in June 1967. Dayan became Israel's foreign minister in 1977. He resigned in 1979 because he believed that the government was not doing enough to bring about peace with the Arabs. He was minister of defense from 1967 to 1974, minister of agriculture from 1959 to 1964, and chief of staff from 1953 to 1958.

In 1939, the British, who then ruled Palestine, imprisoned Dayan for his work with the outlawed *Haganah,* a Jewish militia group. He was released in 1941, during World War II, to fight with the British against the Vichy French. He was wounded in a battle in Lebanon, and lost

WORLD BOOK illustration by Lorraine Epstein

The lemon day lily produces beautiful flowers in loose clusters at the top of a tall, leafless stalk.

his left eye. Dayan also took part in the first Arab-Israeli war of 1948. Dayan was born in Deganiya, Palestine.

Ellis Rivkin

Daye, Stephen (1594?-1668), with his son Matthew, set up and operated the first printing office in what is now the United States. In 1638, the Dayes sailed from England to Cambridge, Massachusetts, with Joseph Glover, a British clergyman. Glover brought along a press, type, and paper. Glover died on the voyage, but the Dayes and Glover's widow set up the press in America. The first publication of the press was the "Freeman's Oath" (1639). No copy of this is known to survive. In 1640, the Dayes printed the *Bay Psalm Book.* Eleven copies of that book still exist. See **Bay Psalm Book.**

Daye, whose name is also spelled *Day,* was born in Cambridge, England. He also worked as a locksmith, and he prospected for iron ore in New England.

Peter M. VanWingen

Dayfly. See Mayfly.

Daylight saving time is a plan in which clocks are set one hour ahead of standard time for a certain period, so that darkness comes an hour later. The plan provides an additional hour of daylight in the evening. Most of the states of the United States observe daylight saving time. Wherever it is observed in the United States, it begins on the first Sunday in April and ends on the last Sunday in October. A state may decide to remain on standard time. States that lie in more than one time zone may use daylight time in one zone and not the other.

The chief purpose of daylight saving time is to save energy by reducing evening use of lighting. As a result, countries often first adopt daylight time during a war or other crisis. The United Kingdom, for example, went on daylight time or what it calls "Summer Time" during World War I (1914-1918). The United States adopted the plan in 1918 but repealed it in 1919. The United States also observed it from Feb. 9, 1942, to Sept. 30, 1945, due to World War II.

After the war, many states established some type of daylight saving time. Beginning in 1967, the entire nation went on daylight time from the last Sunday in April to the last Sunday in October. In the 1970's, a reduction in Arab oil exports caused a fuel shortage in the United States. To conserve energy, Congress enacted daylight time from Jan. 6 to Oct. 27, 1974, and from Feb. 23 to Oct. 26, 1975. Since 1987, daylight time has begun on the first Sunday in April. Joanne Petrie

See also **Standard time.**

Dayton (pop. 166,179; met. area pop. 950,558) is a leading manufacturing center in Ohio. It is called the *Birthplace of Aviation* because Orville and Wilbur Wright, who invented the first successful airplane, lived in the city. Dayton lies in the Miami River Valley in southwestern Ohio. For the location of Dayton, see **Ohio** (political map).

Settlers from Cincinnati founded Dayton in 1796. They chose the site because three major rivers—the Mad, the Great Miami, and the Stillwater—flow together there. This location makes Dayton a natural center of water transportation. The settlers named their town for Jonathan Dayton, the youngest signer of the Constitution of the United States.

Description. Dayton, the county seat of Montgomery County, covers 55 square miles (142 square kilometers). The Dayton metropolitan area occupies 1,692 square miles (4,382 square kilometers) and consists of Clark, Greene, Miami, and Montgomery counties.

Nearly a fourth of Dayton's workers are employed in the city's more than 1,000 manufacturing plants. Major products, in order of value, include nonelectrical machinery, rubber and plastic goods, transportation equipment, electrical equipment, and printed materials. Wright-Patterson Air Force Base, which stands just outside Dayton, is the area's largest employer. NCR Corporation, the world's chief maker of cash registers, has headquarters in Dayton.

A major tourist attraction in the Dayton area is the United States Air Force Museum, located at the air base. The museum features more than 150 planes and missiles. Dayton also has an art institute and a museum of natural history. Educational institutions located in the city include the University of Dayton and Wright State University. Dayton is also the home of the United Theological Seminary.

Government and history. Dayton has a council-manager form of government. The council is called the City Commission. Dayton's voters elect the five commission members to four-year terms. The commission hires a city manager to carry out its policies.

Miami and Shawnee Indians lived in the Dayton area before white settlers first arrived in 1796. During the 1800's, the city grew into a market and transportation center. Many factories were built in the 1800's, creating new jobs. The city's population rose from 38,678 in 1880 to 116,577 in 1910.

In March 1913, heavy rains caused the Mad, Great Miami, and Stillwater rivers to rise and flood the city. The flood killed more than 300 people and caused about $100 million in damage. Later that year, the city adopted the council-manager form of government, with a professional city manager hired to handle the problems caused by the flood. The new system of government took effect in 1914, and Dayton became the first U.S. city with more than 100,000 people to adopt it.

The flood also led to the formation of the Miami Conservancy District in 1915. This agency constructed five dams upstream from Dayton between 1918 and 1922. Today, Dayton and the Miami River Valley have one of the world's most effective flood-control systems.

The Dayton Convention and Exhibition Center opened in the downtown Dave Hall Plaza in 1973. It includes an exhibition hall and a theater. Steven L. Sidlo

Dayton, Jonathan (1760-1824), a New Jersey political leader, was the youngest signer of the Constitution of the United States. Dayton was 26 years old when he attended the Constitutional Convention in 1787. At the convention, Dayton spoke in favor of giving the states strong powers in the new nation.

Dayton was born on Oct. 16, 1760, in Elizabethtown, New Jersey. He graduated from the College of New Jersey at the age of 16. Dayton later became a captain in the Revolutionary War in America (1775-1783). After the war, Dayton pursued his interests in law, politics, and investment. He served as a U.S. representative from 1791 to 1799, and as speaker of the House from 1795 to 1799. From 1799 to 1805, Dayton served as a U.S. senator.

Dayton was charged with high treason in 1807. He was believed to be involved in western political

schemes with Aaron Burr, vice president of the United States from 1801 to 1805. But Dayton was never tried, and he returned to state politics. Dayton took part in an unsuccessful attempt to buy land in the area of Dayton, Ohio, which is named for him. Richard D. Brown

Dayton, William Lewis (1807-1864), was the Republican candidate for vice president of the United States in 1856. He and presidential candidate John C. Frémont were defeated by Democratic candidates James Buchanan (president) and John C. Breckinridge. As a member of the Whig Party, Dayton served as a U.S. senator from New Jersey from 1842 to 1851. He was attorney general of New Jersey from 1857 to 1861 and U.S. minister to France from 1861 to his death. Dayton was born in Basking Ridge, New Jersey. Michael F. Holt

Daytona Beach, Florida (pop. 64,112; met. area pop. 493,175), a resort city, lies on the Atlantic Ocean and the Halifax River (see **Florida** [political map]). It has a hard-packed sand beach on which cars can be driven.

Harbors for yachts and small boats lie in the Halifax River. Hotels, motels, and apartment buildings line its oceanfront and riverbanks. The city offers many recreational facilities. Championship car and motorcycle races are held at the Daytona International Speedway (see **Automobile racing** [picture]). The city is the national headquarters of the Ladies Professional Golf Association (LPGA). The Daytona Beach area's economic activities include tourism, fishing, and the manufacture of electronics components, furniture, suntan products, and boats.

The city was founded in 1870, and incorporated as Daytona in 1876. In 1926, it consolidated with Daytona Beach and Seabreeze, and was chartered as Daytona Beach. The city is the home of Bethune-Cookman College and Embry-Riddle Aeronautical University. It has a council-manager government. Tony Briggs

DC. See **Electric current** (Direct and alternating current).

DDT is an insecticide that has been widely used on crops for pest control. The three letters come from its chemical name, *d*ichloro-*d*iphenyl-*t*richloroethane. DDT is a grayish-white powder that, when used for pest control, is mixed with other substances.

DDT kills insects by affecting the nervous system. It differs from most other insecticides because it lasts a long time. DDT decays slowly and appears in plants and in animals that eat the plants. It also appears in human beings because it is absorbed into the body tissues from the animals and plants that people eat.

Large-scale application of DDT kills useful insects as well as harmful ones, and it may endanger other animal life, including birds and fish. It may also contaminate the food that people eat. Since 1972, the United States government has gradually phased out all uses of DDT. But DDT is still used in other parts of the world.

DDT was first prepared as an insecticide by Paul Müller, a Swiss chemist, in 1939. It became well known during World War II (1939-1945), when the U.S. Army used it to fight typhus in Naples, Italy. DDT destroys body lice, which carry the disease. Harold D. Coble

DEA. See **Drug Enforcement Administration.**

Deacon is one of the classes or ranks of Christian clergy. The term also refers to members of the laity assigned to help ministers and priests in such tasks as preaching and helping the sick and needy. The word *deacon* comes from *diakonos,* a Greek word that means *servant.* The office of deacon is called the *diaconate.*

In the Anglican, Eastern Orthodox, and Roman Catholic churches, the diaconate is mainly a stage of a year or less that precedes priesthood. These churches now also have deacons ordained to the diaconate as a lifetime vocation. These deacons assist in church work, especially if there is a shortage of priests. In many Protestant churches, deacons are lay members who help meet various needs of their congregation. The Anglican church and many Protestant churches have women members of the diaconate called *deaconesses.* Robert S. Ellwood, Jr.

Dead Sea is a saltwater lake in southwestern Asia. Its shore, which lies about 1,310 feet (399 meters) below sea level, is the lowest place on the surface of the earth. The Dead Sea is the saltiest body of water in the world. It is about nine times as salty as the ocean. The lake lies at the mouth of the Jordan River and forms part of the border between Israel and Jordan.

The salty waters of the Dead Sea appear smooth and sparkling. Rocky and barren land surrounds the lake, and steep, brightly colored cliffs rise above its eastern and western banks. The lake is called the Dead Sea be-

Dead Sea

WORLD BOOK maps

cause few plants and no fish except brine shrimp live in its waters. In addition, little plant life grows in the salty soil around the Dead Sea.

The Dead Sea lies in the Ghor, a deep *fault* (break in the earth's outer shell, along which rock has moved). The lake covers about 400 square miles (1,040 square kilometers). It is 11 miles (18 kilometers) wide at its widest point and about 50 miles (80 kilometers) long.

A peninsula called Al Lisan juts into the Dead Sea from its eastern shore and divides the lake into a large northern basin and a smaller southern basin. The lake's deepest part is in the northern basin. In this area, the lake bottom lies 1,312 feet (400 meters) below the surface and about 2,622 feet (799 meters) below sea level.

Since the early 1900's, the water level of the Dead Sea has been slowly falling. The region gets less than 4 inches (100 millimeters) of rain annually. The Jordan River and several streams pour relatively fresh water into the lake. The fresh water mixes with salty water at the surface. But extreme heat in the area causes this water to evaporate rapidly. Thus, the Dead Sea never grows less salty. The high salt content of the water provides great buoyancy, enabling swimmers to float with ease.

The Dead Sea contains large quantities of minerals, including common salt (sodium chloride), bromine, calcium chloride, and potassium chloride. An Israeli company called the Dead Sea Works extracts the minerals from the water for use in making such products as table salt, fertilizer, and drugs.

At the southern end of the lake, a network of dikes forms shallow pools that cover over 40 square miles (100 square kilometers). These pools evaporate and leave behind mineral solids, which are then refined by the Dead Sea Works. Some people believe bathing in the Dead Sea is healthful because of its high mineral content. Several area health resorts provide facilities for bathers.

The Dead Sea was probably formed millions of years ago when the Arabian Peninsula and the African continent shifted and formed the Great Rift Valley (see **Great Rift Valley**). The Dead Sea is mentioned in the Bible as the *Salt Sea* (Genesis 14:3). The ancient cities of Sodom and Gomorrah stood near the lake (see **Sodom and Gomorrah**).

Columns of salt rock on the shore of the Dead Sea may have been the basis for the Biblical story of Lot's wife (see **Lot**). Lot's wife was turned into a pillar of salt as punishment for disobedience to God (Genesis 19:26). Ancient manuscripts known as the *Dead Sea Scrolls* were found in caves near the Dead Sea. These scrolls date from as early as the 200's B.C. (see **Dead Sea Scrolls**).

Bernard Reich

See also **Israel** (Mining; picture); **Asia** (picture).

Dead Sea Scrolls are among the oldest known manuscripts of any Biblical books. Most of them were discovered in or near dry riverbed caves along the western side of the Dead Sea in what are now Israel and the West Bank. The more than 800 scrolls that have been found date from as early as the 200's B.C. Because they were found miles apart and are dated to different centuries, all the scrolls cannot come from one source.

Reports describing the discoveries of texts in the caves have been documented from the A.D. 100's through the Middle Ages. The most famous Dead Sea Scrolls were discovered beginning in 1947. The scrolls were found at a number of sites, including Nahal Hever, Murabbaat, and the fortress of Masada. The most famous site is Qumran, which has yielded the most texts.

Qumran may have housed a working library, but scholars are not sure why the scrolls were collected there. Many scholars believe the residents from about 150 B.C. to about A.D. 68 were members of a Jewish sect called the Essenes (see **Essenes**). The Essenes may have controlled the Qumran manuscripts, but it is not certain if they wrote them, collected them, or owned them. Scholars also do not know if the Essenes put the scrolls in the caves to protect them or to avoid them. Many Qumran texts are literary works, but there are also letters and legal documents that shed light on personal and national events before, during, and after the time of Jesus Christ.

The Dead Sea Scrolls include fragments of every book of the Hebrew Bible, which Christians call the Old Testament, except the Book of Esther. Some texts are almost identical to Bible texts used today. A few are complete or almost complete. The scrolls also include fragments of the Septuagint, the earliest Greek text of the Hebrew Bible. In addition, the scrolls include large parts of an Aramaic translation of Job, and parts of books found only in Roman Catholic and Eastern Orthodox Bibles.

Scholars found previously unknown texts among the scrolls. The so-called Temple Scroll summarizes laws in the Pentateuch, the first five books of the Hebrew Bible. The Manual of Discipline (also called the Community Rule) describes how a community, located in Qumran, organized its spiritual life. The War of the Sons of Light Against the Sons of Darkness offers a detailed plan for the final war awaited by the Qumran community. Other scrolls contain prayers, hymns, commentaries on parts of the Bible, legends, prophecies, religious arguments, and otherwise unknown stories about characters in the Hebrew Bible.

Most of the Dead Sea Scrolls were written in Hebrew on leather or papyrus. One scroll written on copper describes the locations of huge treasures, perhaps from the Temple in Jerusalem. B. Barry Levy

See also **Bible** (picture: The Dead Sea Scrolls).

Additional resources

Shanks, Hershel. *The Mystery and Meaning of the Dead Sea Scrolls.* Random Hse., 1998.

Wise, Michael, and others. *The Dead Sea Scrolls: A New Translation.* 1996. Reprint. Harper San Francisco, 1999.

Deadly nightshade. See Belladonna.

Deadwood Dick. See Love, Nat.

Deafness is commonly defined as the inability to hear and understand speech. But there is no legal definition of deafness, and experts do not completely agree when to use the term. Hearing specialists generally distinguish between a person who is *deaf* and a person who is *hard of hearing.* Most people who are hard of hearing can hear and understand some speech if it is loud enough. But they may be unable to hear other sounds, such as doorbells or high musical notes. In addition, the quality of sounds they do hear may be distorted.

Deaf children and children who are severely hard of hearing have great difficulty learning to speak. For nondeaf children, hearing the speech of others is an im-

WORLD BOOK photo

Speech therapy can help some deaf students learn to speak. The therapist shown here is working with a child at school. She is teaching the child how to make the sounds involved in speaking. The student is learning with the help of a hearing aid.

portant part of learning to speak. But deaf children cannot hear speech. Many deaf people never learn to speak well enough to be understood. Instead, they use sign language and other special methods to communicate.

Hearing loss is a common disability and millions of people throughout the world are deaf. Although deafness poses special challenges, the condition need not hinder achievement in a wide variety of occupations. The German composer Ludwig van Beethoven wrote some of his finest music after he became deaf. The American inventor Thomas Edison was deaf much of his life. Helen Keller became a noted author and lecturer despite being blind and deaf.

Types of hearing loss

There are two major types of hearing loss, *conductive disorders* and *sensorineural* (pronounced *SEHN suhr ee NUR uhl*) *disorders*. Some people suffer a combination of these conditions called a *mixed hearing loss*.

Conductive disorders result from conditions that interfere with the passage of sound through the outer ear or the middle ear. Sound normally enters the outer ear and passes down the ear canal to a thin membrane called the *tympanum (TIHM puh nuhm)* or eardrum. The eardrum vibrates in response to sound and activates three tiny bones called *ossicles (AHS uh kulhz)* in the middle ear. The ossicles transmit vibrations from the eardrum to the inner ear. Most cases of conductive hearing loss are due to diseases that prevent the ossicles from working properly.

Sensorineural disorders involve some defect in the inner ear or the *auditory nerve,* which leads from the inner ear to the brain. The inner ear contains the actual organ of hearing, called the *organ of Corti*. This organ converts the vibrations transmitted to the inner ear into electrical signals. The auditory nerve then carries these signals to the brain. The auditory nerve and the structures of the organ of Corti are extremely delicate and may be damaged by a wide variety of factors.

Causes of hearing loss

Diseases cause most cases of conductive hearing loss. The leading cause is called *otitis media (oh TY tihs MEE dee uh)*. In otitis media, a cold or some other infection spreads to the middle ear and causes it to fill with fluid. The pressure of this fluid reduces the ability of the eardrum and ossicles to transmit vibrations. Otitis media occurs most commonly in early childhood and can lead to serious hearing loss if not treated promptly.

The other major cause of conductive hearing loss is *otosclerosis (OH tuh sklih ROH sihs)*. In otosclerosis, a bony growth forms around the base of the *stapes (STAY peez),* the ossicle next to the inner ear. This growth prevents the stapes from moving and passing vibrations to the inner ear. Doctors think otosclerosis is hereditary. It may begin to affect hearing at any age but is usually not detected until the teen-age years or later.

Some diseases, including *meningitis (MEHN ihn JY tihs),* can cause sensorineural disorders. Meningitis is an infection of the membranes that cover the brain. Other diseases accompanied by a high fever can also severely damage the inner ear and the auditory nerve. A disorder of the inner ear called *Ménière's (may NYAYRZ) disease* also causes hearing loss, especially among people over 40 years old. This disorder, which affects millions of people, often disturbs the sense of balance.

Birth defects account for many cases of sensorineural deafness. Some inherited defects affect the *auditory* (hearing) system at birth or during infancy. Other inherited conditions may lead to hearing loss later in life.

A woman who has rubella (also called German measles) during pregnancy may give birth to a child with a hearing loss. Rubella, especially if it strikes during the first three months of pregnancy, may interfere with development of a child's ears and nervous system.

A condition called *erythroblastosis fetalis (ih RIHTH roh blas TOH sihs fih TAL ihs)* can damage hearing before birth. The blood of most unborn children has a substance called the *Rh factor*. If the mother's blood lacks this factor, her body may produce substances that attack the Rh factor and damage the baby's auditory system.

Environmental factors, such as accidents and exposure to loud noise, can damage a person's hearing. A hard blow to the head can cause permanent hearing loss. Such injuries may affect the eardrum, the bones of the middle ear, or even parts of the inner ear.

Exposure to loud noises can lead to serious hearing loss by damaging the organ of Corti. Extremely loud sounds, such as explosions or gunshots, can produce sudden deafness. But much of the lost hearing eventually returns in many of these cases. Exposure to loud noise over a long period can gradually cause permanent loss of hearing. Many people who work in extremely noisy factories eventually suffer considerable hearing loss. Listening to loud music for long periods can also damage hearing. In addition, many experts feel that prolonged exposure to loud noises is a major cause of *tinnitus (tih NY tuhs),* also called ringing in the ears. Doctors recommend that people avoid loud noises whenever possible or protect themselves with ear plugs or other devices that muffle noise.

Aging. Almost all people over 65 years old experience some loss of hearing. About one-third of older

adults throughout the world have hearing problems severe enough to seriously impair their ability to communicate. Hearing loss in old age, called *presbycusis (prehz bee KYOO sihs),* may result from illness or exposure to loud noise earlier in life. Some hearing specialists believe aging also causes changes in the auditory system or in the brain that reduce hearing ability.

Living with hearing loss

Detection of hearing problems. Experts called *audiologists* are specially trained to detect and diagnose hearing problems. An audiologist tests a person's hearing in a soundproof room using an instrument called an *audiometer.* There are two main types of audiometers, *pure-tone audiometers* and *speech audiometers.* Pure-tone audiometers use simple vibrations of various tones at different volumes to measure hearing. Speech audiometers use spoken words or sentences.

Audiologists also have methods to check the hearing of infants and other people who cannot participate in the testing process. These methods involve measuring changes in brain waves and other involuntary responses to sound. A child's hearing should be tested within a few days after birth if doctors suspect a hearing loss. Many schools test children's hearing annually.

Medical treatment. Physicians can restore hearing partially or completely in many cases of conductive hearing loss. Doctors may use penicillin or other antibiotics to treat otitis media. In severe cases of this infection, a small incision may be made in the eardrum to drain fluids that have collected in the middle ear. Doctors may insert tiny drainage tubes in the eardrum to treat long-lasting infections.

Some conductive disorders are treated by surgery. For example, a ruptured eardrum can be repaired surgically. Surgery involving the stapes can restore the ability of the middle ear to transmit sound in patients suffering from otosclerosis. One operation frees the stapes from the bony growth that has trapped it. In another procedure, the surgeon completely removes the stapes and replaces it with an artificial device.

Most sensorineural disorders cannot be treated medically because damage to the inner ear or auditory nerve is permanent. But an operation called a *cochlear (KAHK lee uhr) implant* can help some people. In this operation, a surgeon attaches a device inside the *cochlea,* the part of the inner ear that contains the organ of Corti. This device converts sounds into electrical signals. The signals are then picked up by the auditory nerve and transmitted to the brain. The risks and possible benefits of getting a cochlear implant differ, depending on each individual's situation. Many experts think that an implant is most likely to help people who lost their hearing after they learned to talk and understand speech.

WORLD BOOK photo by Dan Miller

Testing for hearing disorders is usually done by trained experts called *audiologists.* The audiologist shown here is using a device called an *audiometer* to test a child's hearing.

Special language techniques. Many people who are deaf or hard of hearing use *speech reading* and *manual communication* to help them communicate. Speech reading, also called *lip reading,* involves understanding what is said by watching the movements of the speaker's mouth, face, and body. In manual communication, people talk primarily with their hands.

Manual communication usually involves both *finger spelling* and *sign languages.* In finger spelling, a different hand signal represents each letter of the alphabet. In sign languages, hand signals stand for objects and ideas. Sign languages are used throughout the world in the same rich variety as spoken languages. Major sign languages used in English-speaking countries include American Sign Language, also known as ASL; British Sign Language; and Signed English.

Deaf people use manual communication to converse with people who understand finger spelling and sign language. They also communicate by speaking and speech reading, or by writing. Some use a method called *cued speech,* which combines hand signals and facial movements to represent the sounds of spoken words. In addition, deaf people may use professional interpreters who are nondeaf and know manual communication.

Special devices. Many deaf and hard of hearing people use electronic hearing aids to amplify sound. An *analog* hearing aid works much like a telephone. It converts sound to electrical energy, amplifies the energy, and then changes it back into amplified sound. A *digital* hearing aid converts sound into an electrical signal that is *digitized* (represented by numbers). A digital hearing aid includes a small computer that can process the digitized signal in a way that best suits an individual's needs. Hearing aids work for people with conductive disorders, but these devices may have limited value for sensorineural defects. An audiologist can recommend the proper hearing aid for a patient.

Some deaf people also use other aids in their daily lives. For example, visual, audible, and vibrating signals alert deaf and hard of hearing people to sounds they might otherwise miss. Visual signals are the most common alerting devices. They include lights that flash when a telephone, doorbell, or alarm clock rings. Many smoke detectors also have light signals. Audible devices, including extremely loud sirens or telephone bells, may be useful for people with mild or moderate hearing loss. Vibrating devices signal a deaf person by shaking a chair or mattress. Deaf and hard of hearing people may also wear pagers that vibrate when receiving a signal. The American Humane Association provides an additional resource by training dogs to serve as "hearing ear dogs" for the deaf. These dogs alert their owners to specific sounds, such as alarms or doorbells.

Deaf individuals can make and receive telephone calls by using a special device called a TDD (Telecommunica-

© Doug Martin, Photo Researchers

A telecommunication device called a TDD (Telecommunication Device for the Deaf) enables a deaf person to use a telephone. Messages appear on a screen or are printed on paper.

tion Device for the Deaf), also called a TTY or a TT. A TDD connects to a telephone line with a *modem* (electronic device that converts sounds into digital signals). Both the caller and the person receiving the call must have a TDD. The message is typed in at the caller's TDD and typed out at the TDD on the receiving end.

Television and motion pictures can be adapted for deaf viewers by including *captions* (printed dialogue) on the screen. The United States government sponsors Captioned Films for the Deaf, an agency that captions and distributes popular films. The Federal Communications Commission (FCC) requires TV stations to caption weather warnings and all other emergency bulletins.

The FCC also reserves part of the TV signal for broadcasting captions. In 1980, many television stations in the United States began to provide *closed captioning* for some of their programs over the reserved part of the signal. Closed captions are invisible until a decoder makes them appear on the TV screen. Closed captioning is also available in Australia, Canada, England, and certain other countries around the world.

In the United States, the Americans with Disabilities Act (ADA) of 1990 protects people with disabilities—including deaf and hard of hearing people—from discrimination by employers. The law also requires that government services and public facilities, such as libraries, museums, and doctors offices, provide access for people with disabilities. For example, the ADA requires the establishment of telephone *relay services* throughout the United States. Relay services enable a deaf person using a TDD to communicate with a person using an ordinary telephone. The person placing the call contacts a relay service operator, who then contacts the other party. Using special equipment, the operator relays the conversation word for word between the parties.

Since the ADA became law, many employers have made changes that enable deaf people to communicate more easily with hearing co-workers. A number of colleges and private organizations provide interpreters during classes and programs. Many local governments now ensure that deaf and hard of hearing people can directly summon emergency services. Governments also help people with hearing loss to communicate in court.

Education. Many deaf children receive their elementary and high school education in special schools or in classes with specially trained teachers. Hard of hearing children may attend special classes or enroll in regular classes and obtain expert assistance as needed. Many deaf and hard of hearing children are *mainstreamed*—that is, placed in classrooms with nondeaf children.

Three main methods of teaching deaf children to communicate are the *oralist method, total communication,* and *sign communication.* In the oralist method, children are taught to speak and to speech read. In total communication, they learn manual communication as well as speech and speech reading. Sign communication focuses on manual communication.

Deaf children can learn manual communication more easily than they can learn to speak. Supporters of the oralist method claim that children who learn manual communication will continue to rely on this technique and never develop their potential for speech. However, supporters of total communication believe that deaf children should learn all possible means of communication and decide which methods best meet their needs.

Teaching deaf children to speak requires special techniques. Nondeaf people learn to talk by hearing others talk. But deaf children must use sight and touch to experience spoken words. They watch their teacher make a sound. They also touch the teacher's face and throat to feel the vibrations and the flow of breath involved in making the sound. Then they try to produce the same vibrations and breath effects themselves.

After deaf students graduate from high school, they may attend regular colleges or go to special institutions of higher education. Gallaudet University, in Washington, D.C., is the world's only liberal arts college for deaf people. The National Technical Institute for the Deaf in Rochester, New York, also accepts only deaf students.

Treatment of hearing loss and appropriate education can prepare deaf people to do almost any kind of work. But some deaf people have difficulty finding jobs suited to their education and abilities. Such organizations as the Alexander Graham Bell Association for the Deaf, the Convention of American Instructors of the Deaf, and the National Association of the Deaf promote the education, training, and employment of deaf people.

Deaf community and culture. Deaf people have created a network of agencies, clubs, churches, publications, and other resources that meet their special needs. This network of relationships and resources is commonly called the *deaf community.* Some deaf people regard their deafness as an extremely important part of their identity and function almost exclusively within the deaf community. A number of these people consider themselves *culturally deaf.* Some members of deaf culture prefer to call themselves *Deaf* with a capital *D* to show their commitment to the deaf community.

Most of the culturally deaf lose their hearing in infancy or early childhood. They begin their involvement in deaf culture by attending special schools. Because they have difficulty communicating with the nondeaf, many deaf people find it more rewarding to relate to others who share a common language. Most deaf people pre-

fer to communicate using ASL because they do not think Signed English and cued speech are acceptable languages. Culturally deaf people generally take great pride in their lack of hearing and do not consider themselves disabled. They see outdated beliefs and practices as the principal barriers faced by deaf people.

The deaf culture movement gained strength in the United States with a 1988 protest at Gallaudet University. Students and faculty struck to protest appointment of a nondeaf woman as the school's president. The appointee resigned under pressure, and American educator I. King Jordan was then selected as Gallaudet's first deaf president. Jordan's supporters felt that his appointment demonstrated the university's high goals and expectations for all deaf people. John B. Christiansen

Related articles in *World Book* include:

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Bell, Alexander Graham	Ear	Lip reading
Bridgman, Laura Dewey	Gallaudet	Sign language
Closed captioning	Gallaudet University	Speech therapy
Disabled	Hearing aid	Sullivan, Anne Mansfield

Additional resources

Rezen, Susan V., and Hausman, C. D. *Coping with Hearing Loss: A Guide for Adults and Their Families.* Rev. ed. Barricade, 1993.

Turkington, Carol, and Sussman, A. E. *The Encyclopedia of Deafness and Hearing Disorders.* Facts on File, 1992.

Dean, Dizzy (1911-1974), was one of baseball's greatest pitchers and most colorful personalities. He pitched for the St. Louis Cardinals and the Chicago Cubs from 1932 to 1941. He won 30 games in 1934. He and his brother Paul (Daffy) each pitched two victories for St. Louis over the Detroit Tigers in the 1934 World Series.

Dean was born on Jan. 16, 1911, in Lucas, Arkansas. His real name was Jay Hanna Dean, but he also used the name of Jerome Herman Dean. He quit school after the second grade. He picked cotton until he was 16 years old. Dean became a professional baseball player in 1930. Dean developed a sore arm in 1937 and was traded from St. Louis to the Chicago Cubs in 1938. His arm never returned to normal and early in the 1941 season he retired from baseball to become a sports announcer. Dean returned to baseball for one game in 1947.

As a radio and television sports announcer, Dean became famous for his quaint announcing style. He often used such expressions as "The runner *slud* into third," and "He *throwed* the ball." Dean was elected to the National Baseball Hall of Fame in 1953. Dave Nightingale

Dean, James (1931-1955), was an American motion-picture actor. He became famous for his intense, brooding portrayals of discontented, rebellious young men. Dean starred in only three movies—*East of Eden* (1955), *Rebel Without a Cause* (1955), and *Giant* (1956). He died in an auto accident at the age of 24. After his death, he became an idol to young people in many parts of the world. They considered Dean a symbol of their frustrations because of the characters he portrayed.

Dennis Stock, Magnum

James Dean

James Byron Dean was born on Feb. 8, 1931, in Marion, Indiana. He studied acting at the University of California at Los Angeles and at the Actors Studio in New York City. Dean acted in TV dramas before beginning his film career. He also was in two Broadway plays, *See the Jaguar* (1952) and *The Immoralist* (1954). Roger Ebert

Deane, Silas (1737-1789), was an early American diplomat. He helped gain vital French aid for the American Colonies during the Revolutionary War (1775-1783).

In 1776, the Continental Congress sent Deane to France to purchase military supplies, arrange trade agreements, and hire soldiers. Congress ordered him to return in 1777 to face charges of disloyalty and financial misconduct. Arthur Lee, one of Deane's fellow diplomats, had accused him of trying to make a profit for himself by charging the U.S. government for supplies that the French had intended as gifts. The charges were never proved. Deane became bitter over what he saw as his country's ingratitude. He returned to France in 1780 and lived in Europe as an exile until his death.

Deane was born Dec. 24, 1737, in Groton, Connecticut. He graduated from Yale College and began practicing law. He represented Connecticut in the first and second Continental Congresses. William Morgan Fowler, Jr.

De Angeli, *dee AN juh lih,* **Marguerite Lofft** (1889-1987), was an American author and illustrator of children's books. She was best known for her stories about minority groups. *Thee Hannah!* (1940) is about a Quaker girl, and *Yonie Wondernose* (1944) tells the story of a Pennsylvania Dutch boy. *Bright April* (1946) describes a black girl's experience with racial prejudice. De Angeli won the 1950 Newbery Medal for *The Door in the Wall* (1949), a story of England in the 1300's. She collected and illustrated a *Book of Nursery and Mother Goose Rhymes* (1954). Her poems were published in *Friendship and Other Poems* (1981). De Angeli was born on March 14, 1889, in Lapeer, Michigan. Jill P. May

Dearborn, Michigan (pop. 97,775), is the headquarters of the Ford Motor Company. The city lies in southeastern Michigan (see **Michigan** [political map]). Its chief products, in addition to automobiles made by Ford, include steel and heating and air-conditioning equipment.

Dearborn's attractions include Fair Lane, the former estate of pioneer automobile manufacturer Henry Ford; the Henry Ford Museum; and Greenfield Village, a group of historical buildings and landmarks. Dearborn is the home of a campus of the University of Michigan, Henry Ford Community College, and the Dearborn Historical Museum. The city maintains Camp Dearborn, a 626-acre (253-hectare) recreational facility 35 miles (56 kilometers) to the northeast.

Wyandot Indians were the first inhabitants of the area that is now Dearborn. White pioneers settled there in 1795. The village of Dearborn was formed in 1893. The village was incorporated as a city in 1927. It was named for United States political leader Henry Dearborn.

Between 1917 and 1919, Henry Ford built his main automobile plant in Fordson, adjacent to Dearborn. Dearborn annexed Fordson in 1929. Dearborn has a mayor-council form of government. Peter Gavrilovich

See also **Dearborn, Henry; Ford, Henry; Ford Motor Company.**

Dearborn, Henry (1751-1829), was an American soldier and political leader. Fort Dearborn in Chicago was named for him (see **Fort Dearborn**). He was born in North Hampton, New Hampshire, and served as a captain in the Revolutionary War in America. He fought at Bunker Hill in 1775 and went with Colonel Benedict Arnold to Quebec, Canada, later that year. Dearborn was serving as a major at the Battle of Saratoga in 1777 when the British general John Burgoyne surrendered. Dearborn served in the United States Congress from 1793 to 1797 and was secretary of war in President Thomas Jefferson's Cabinet from 1801 to 1809. He was a major general during the War of 1812 and served as minister to Portugal from 1822 to 1824. Richard D. Brown

Death is the end of life. Every living thing dies, but human beings are probably the only creatures that can imagine their own deaths. Most people fear death and try to avoid thinking about it. But the awareness of death has been one of the chief forces in the development of civilization. Throughout history, people have sought medical knowledge with which to delay death. Philosophers and religious leaders have tried to understand the meaning of death. Some scholars believe that much human progress results from people's efforts to defy death and gain immortality through lasting achievements.

Traditionally, people have confronted death within a set of religious beliefs that gave it meaning outside the natural world. Funeral customs have helped them deal with the grief that accompanies losing a loved one. But now a growing number of people view death more as a biological process. Other people see death as a threatening prospect and choose to deny it. Still others regard death as a challenge. They seek to delay aging or to defeat death through medical science or by other means.

Medical aspects of death. Scientists recognize three types of death that occur during the life of all organisms, except those consisting of only one cell. These types are *necrobiosis, necrosis,* and *somatic death.*

Necrobiosis is the continual death and replacement of individual cells throughout life. Except for nerve cells, all the cells of an organism are constantly being replaced. For example, new skin cells form under the surface as the old ones die and flake off.

Necrosis is the death of tissues or organs. During a heart attack, for example, a blood clot stops the blood flow to part of the heart. The affected heart muscle dies, but the heart may continue to beat. But if the damage is severe, the heart stops beating and death follows.

Somatic death is the end of all life processes in an organism. A person whose heart and lungs stop working might be considered clinically dead, but somatic death might not yet have occurred. The individual cells of the body live on for several minutes. The person may be revived if the heart and lungs start working again and give the cells necessary oxygen. After about three minutes, the brain cells begin to die. The person is soon dead beyond any possibility of revival. Gradually, other cells of the body also die. The last to die are the bone, hair, and skin cells, which can keep growing for several hours.

Many changes occur after death. The body temperature slowly drops to that of the environment. The muscles develop a stiffening called *rigor mortis.* The blood settles and produces bruiselike discolorations in the lowest areas of the body. Eventually, bacteria and other tiny organisms grow on the corpse and cause decay.

Defining death. Traditionally, a person whose heartbeat and breathing had stopped was considered dead. But today, doctors can artificially prolong the working of the heart and lungs. Machines can maintain a heartbeat and breathing even in a patient whose brain has been destroyed. These new procedures have led people to demand a new definition of death.

In the United States, for example, most states have adopted the Uniform Determination of Death Act of 1980. Under this act, a person is dead when the heartbeat and breathing irreversibly stop, or when brain function totally and irreversibly stops, a condition called *brain death.* The act allows doctors to use accepted medical standards in applying this definition. For example, doctors may run tests to try to detect brain activity.

The brain-death definition of death raises important medical, legal, and moral questions. People who support this definition argue that it provides vital organs for transplants. Usually, the organs of a person who has died under the traditional definition are damaged and cannot be transplanted. But many vital organs remain functional in an individual whose body processes are maintained by machine, though brain activity has stopped. Doctors can use these organs in transplants—if brain death is accepted as a legal definition.

The right to die. Many people believe that physicians should use all means to maintain a patient's life as long as possible. But others argue that dying patients and their doctors have the right to stop treatment that would only temporarily extend life. Some people also feel that the patient's family and physician have the right to stop treatment when the patient can no longer express his or her wishes. In 1990, the Supreme Court of the United States ruled that patients who have clearly made their wishes known may discontinue life-sustaining treatment. Withdrawal of such treatment is sometimes called *passive euthanasia.*

Some people draw up an *advance directive.* One such document is called a *living will,* in which they express their wishes about what kind of care they want to receive when they are near death and unable to communicate. Most U.S. states have laws that recognize living wills under certain circumstances.

Another type of advance directive is the *durable power of attorney for health care.* In this type, patients appoint another person or group to speak for them if they are unable to make medical decisions. It is more personal than a living will, and covers health care treatments throughout a patient's life, not just at the time of dying. Most U.S. states and numerous countries recognize this form.

Some people feel that hopelessly ill patients should have the right to refuse treatment but also to request *physician-assisted suicide.* In this type of *active euthanasia,* a doctor helps a patient by providing the means to die painlessly and with dignity. In the United States, physician-assisted suicide is legal only in Oregon.

Supporters of physician-assisted suicide feel that life-extending techniques have created a need for new approaches to end-of-life care. They feel that such care should include help with dying if patients can think clearly and freely request help. In the Netherlands, physicians are allowed to go further and carry out eu-

thanasia under strict guidelines when it is requested by terminally ill patients. Others oppose physician-assisted suicide because they believe any form of suicide is morally wrong. Critics also fear that physician-assisted suicide could lead to other forms of active euthanasia.

Attitudes about death changed during the 1900's. About 1900, most deaths were those of children killed by diphtheria, pneumonia, or other infectious diseases. People usually died at home, close to their families. People were familiar with death and saw it as natural.

Today, except for the young adults who die of AIDS, most people die of heart disease, cancer, stroke, or other diseases associated with aging. As a result, many young people have little experience with death. This lack of experience makes it difficult for them later as adults to talk about death or to be with a dying person.

The increase in human lifespan has also affected attitudes about dying. Many people have come to view the elderly as having "lived out their lives" and experience the death of an elderly person as a natural, inevitable event. The death of a child or young adult, however, is considered unjust. Such a death generally has more complicated emotional consequences.

Television and other media also influence attitudes about death. Violent deaths are becoming more visible in the news. The media often report murders in schools, street violence, and ethnic and religious conflicts throughout the world. Witnessing violent deaths can be especially disturbing for children, who might require special grief counseling. Many people criticize the media for presenting violence in children's programs, and for their live coverage of fighting and violent crimes. These critics feel that by presenting violence, the media encourage even more of it.

During the mid-1900's, many psychologists and others became interested in the special emotional needs of the dying. Studies showed that friends, relatives, and even doctors and nurses avoided dying patients because of their own feelings about death. As a result, many critically ill patients suffered from loneliness. To help solve this problem, some medical schools, hospitals, colleges, and churches organized death education courses. These courses provided people with knowledge about death and the needs of dying individuals. David C. Thomasma

Related articles in *World Book*. See Funeral customs and its list of *Related articles*. See also the following articles:
Euthanasia
Hospice
Immortality
Reincarnation
Resurrection
Suicide

Additional resources

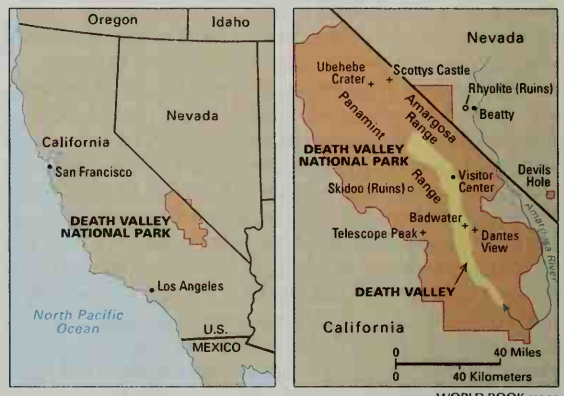
Muth, Annemarie, ed. *Death and Dying Sourcebook*. Omnigraphics, 2000.
Sprung, Barbara. *Death*. Raintree Steck-Vaughn, 1998. Younger readers.

Death penalty. See Capital punishment.

Death rate. See Birth and death rates.

Death Valley lies chiefly in east-central California. A small part of it extends into Nevada. A group of pioneers named the valley for its desolate desert environment after they crossed it in 1849. It is part of the Death Valley National Park.

Death Valley is a deep trough, about 130 miles (209 kilometers) long and from 6 to 14 miles (10 to 23 kilometers) wide. The lowest elevation in the Western Hemisphere is near Badwater in Death Valley. It lies 282 feet (86 meters) below sea level. The Panamint Mountains stand west of the valley. Telescope Peak in the Panamint range is 11,049 feet (3,368 meters) high. The Amargosa Range, composed of the Grapevine, Funeral, and Black mountains, rises to the east.



WORLD BOOK maps

Location of Death Valley

Keith Gunnar, Bruce Coleman Inc.

Death Valley is in east-central California. The valley's Badwater area, *shown here,* lies at the foot of the Panamint Mountains.

The valley is a *graben*—a block in the earth's surface, dropped down by faults that form its east and west walls. *Faults* occur when the earth's rocky outer shell breaks and the rock along the break slips. Erosion of the steep cliffs has formed beautiful canyons. In the northern part of the valley is Ubehebe Crater, a small volcano on the west side fault. Flows of lava issue from the faults in the southern part of Death Valley.

During glacial times, the climate was moister, and a large lake occupied Death Valley. Today, rainfall averages about 2 inches (5 centimeters) a year there. The highest temperature ever recorded in the United States, 134 °F (57 °C), was reported there on July 10, 1913. Summer temperatures of 125 °F (52 °C) are common. The valley's geological attractions and warm winter sunshine have made it a popular winter-resort area. Plants include the creosote bush, desert holly, and mesquite. Wildlife includes bobcats, coyotes, foxes, reptiles, and squirrels.

Borax deposits were discovered in 1873. Actual mining began in the early 1880's, and famous 20-mule teams

hauled the borax out of the valley. Prospectors also discovered copper, gold, lead, and silver in nearby mountains. Mining towns sprang up, with such colorful names as Bullfrog, Greenwater, Rhyolite, and Skidoo. The towns died when the ores were exhausted. Today only cluttered debris remains. John Edwin Coffman

See also **United States** (picture).

Death Valley National Park lies chiefly in California. Its northeast corner extends into Nevada. The park is a hot, dry region of scenic and historic interest. It is named for Death Valley, which lies within the park. Death Valley includes the lowest point in the Western Hemisphere. This location, near Badwater in California, is 282 feet (86 meters) below sea level. For details on the valley, see **Death Valley** (with map). In addition to Death Valley, the national park includes mountainous areas and remains of old mining settlements.

The area became a national monument in 1933. In 1994, the boundaries were expanded and it became a national park. For the area of the park, see **National Park System** (table: National parks).

Critically reviewed by the National Park Service

Death's-head moth is a large moth with a thick, hairy body. Many superstitions arose because of the skull-like pattern on its body. The death's-head moth is a type of *hawk moth* (see **Hawk moth**). The moth lives in Africa and southern Europe, and adults often migrate to northern Europe. They enter beehives to eat honey and may squeak loudly when disturbed. The caterpillar is bright yellow with violet stripes and blue spots. It feeds on the leaves of potato plants. Bernd Heinrich

Scientific classification. The death's-head moth belongs to the family Sphingidae. It is *Acherontia atropos*.

Deathwatch is a name given to several kinds of small brownish beetles that communicate by knocking their heads against wood. This odd action produces a peculiar ticking or rapping sound. Superstitious people believe that the rapping, heard in the quiet of the night, foretells death in the house. Deathwatch beetles burrow into furniture and woodwork and are often very destructive. The *drugstore beetle,* which feasts on drugs and spices stored in shops, is sometimes called the deathwatch. But it belongs to a different beetle family.

David J. Shetlar

Scientific classification. Deathwatch beetles belong to the family Anobiidae.

DeBakey, Michael Ellis (1908-), an American surgeon, won fame for his work with the heart and for his contributions to techniques used to replace damaged blood vessels, including the coronary bypass operation. In 1966, DeBakey and American surgeon Adrian Kantrowitz successfully implanted the first *assisting heart.* Inserted into the chest, this machine helps a weak heart pump blood until either the heart recovers or surgeons transplant another person's heart. DeBakey also worked on the development of an artificial heart.

DeBakey became the first person to surgically repair an aneurysm, a condition in which the wall of a blood vessel weakens and balloons out. He replaced the weakened part of the vessel with another blood vessel (see **Aneurysm**). He later developed artificial blood vessels made of Dacron.

DeBakey was born on Sept. 7, 1908, in Lake Charles, Louisiana. He earned an M.D. degree from Tulane University. He became head of the Department of Surgery at Baylor University in 1948. He served as president of Baylor College of Medicine from 1969 to 1979, then as chancellor from 1979 to 1996. Eric Howard Christianson

Debate is a series of formal spoken arguments for and against a definite *proposition.* A proposition is a carefully worded statement that makes clear the positions of both the affirmative and negative sides.

Debate differs from discussion. *Discussion* is the process by which a problem is recognized, defined, and investigated, and then solutions are explored. *Debate* is the process that evaluates a probable truth, a judgment, a causal relationship, or a single solution.

Formal debate. In formal debating, the same number of people speak for each side. They have the opportunity to reply directly to opposing speakers. Affirmative and negative speakers usually alternate, and all the speeches are limited in time. In informal (as in conversation) and in legislative debating, though there is the same opportunity to reply to opposing speakers, the speeches are not necessarily limited in time. There may be no attempt to alternate opposing speakers, and the number of speakers on each side may be unequal.

Propositions. Subjects for debates are expressed in the form of propositions. Propositions should be:

(1) Appropriate to the knowledge, experience, and interests of both speakers and audience.

(2) Debatable—that is, not obviously true or false. The statements should involve an honest difference of opinion, with arguments and evidence on both sides.

(3) Phrased in the affirmative. Positive statements prevent confusion by making the issue clear-cut.

(4) Restricted to set forth only one idea. This policy keeps the debate within narrow limits.

(5) Worded clearly. The words should be ones that can be defined exactly, so the debate does not become a mere quibble over the meaning of words.

There are four kinds of propositions: (1) propositions of fact, (2) propositions of value, (3) propositions of explanation, and (4) propositions of policy.

A proposition of fact is a statement to be proven true or false as the evidence is gathered. For example, the proposition, "Resolved, that Main High School will defeat East High School in varsity football next week," is neither true nor false at the present time. After the game, the proposition is no longer debatable. It is a fact that Main High School either won, lost, or tied. Propositions of fact are usually resolved in debate by awarding the decision to the team that presents the best evidence and that establishes probable truth. A proposition of fact is not a fact. *Facts* are truths proved only through such means as experiment, testing, measurement, or scientific observation.

A proposition of value contains a relative term that makes a value judgment. For example, in the proposition, "Resolved, that John Jones did a good job as student council president," the word *good* cannot be precisely defined. The meaning of *good* depends on the value that is given to it. It may have several meanings: (1) John was kind to council members, (2) John was politically successful, (3) John achieved his agenda, or (4) John was moral. In order to debate a value proposition, debaters must define the value term, convince the audience that this definition is reasonable, and apply it to the

subject of the proposition (John).

A proposition of explanation attempts to determine whether a cause and effect relationship exists between two actions or events. For example, the proposition, "Resolved, that oily rags left in the attic caused the fire," asks whether the rags were a necessary and sufficient factor to produce the fire.

A proposition of policy evaluates potential courses of action. It answers the question, "should we change?" A proposition of policy may argue for a new program: "Resolved, that the federal government should finance elementary and secondary public education in the United States." A proposition of policy may want to end a policy: "Resolved, that trial by jury should be eliminated in civil cases." It may also want to substitute one policy for another: "Resolved, that tackle football should be replaced by touch football."

Analysis. After a subject has been selected and the proposition carefully worded, the next step is analysis of the proposition by both debating teams. Analysis of the proposition begins with a broad understanding of it. As a team member, you should know as much about your opponents' case as you know about your own side. Good debaters study the origin and history of a proposition, define its terms, and survey carefully all the arguments and evidence for and against it. Policy analysis usually follows one of two outlines:

Does a new condition exist in the present system?
Is that condition harmful to people or nations?
Is the harm significant in scope and/or intensity?
Is the present policy the cause of the harm?
Can (or will) the present policy solve the harm?
Will the proposition solve the harm?
Will the proposition produce new harms?

or

Will the proposition create a new situation?
Is this new situation advantageous?
Are the advantages significant or widespread?
Are the advantages unique only to the proposition?
Will disadvantages result from adopting the proposition?

The case. Both affirmative and negative sides need to prepare a *case.* A case is a group of arguments. Two common affirmative cases are the *need case* and the *comparative-advantages case.* The need case attempts to show that a significant harm exists, that the present policy either has caused the harm or cannot solve it, and that the action proposed will solve the harm. The comparative-advantages case argues that there is an opportunity for improvement. The affirmative side argues that the action urged in the proposition will yield significant advantages that the present policy cannot produce. The negative approach to the affirmative case may defend the present policy as being good. The negative side may also reject both the present policy and the proposition, and present an alternative.

The plan. The affirmative side needs to present a workable procedure to put the proposition into effect. Such a procedure usually focuses on four steps: (1) the goal, (2) administration, (3) funding, and (4) enforcement. The negative side usually will raise one or more objections to the plan. Examples are: "The plan will not work." "The plan will not solve the harm." "The plan will create new harms."

The issues. The chief points of difference between the affirmative and the negative are the *main issues.* These may have divisions called *subordinate issues.* There must be a clash of opinion on both the main and the subordinate issues. A good way to help find the issues is to list the opposing arguments in parallel columns. In the subject, "Resolved, that the United States should abolish the Electoral College and adopt a system that would provide for the election of the president by direct popular vote," a listing of opposing arguments might lead to the following two main issues and six subordinate issues:

I. Would electing the president by direct popular vote correct flaws in the present system?
- A. Would it be more democratic and give each voter an equal voice in choosing the winner?
- B. Would it assure that the candidate with the most votes is elected?
- C. If no candidate receives a majority of the votes, would this system reduce the chances of political deals and an electoral crisis?

II. Would electing the president by direct popular vote have disadvantages?
- A. Would it weaken the power of the small states and threaten the federal system?
- B. Would it encourage the formation of small political parties and make it difficult for the winner to receive a majority of the votes?
- C. Would it reduce the power of minority groups to influence an election?

The evidence. After the issues have been determined, the next step for the debaters is to find the evidence that will prove the issue true or false. Evidence can be in the form of *factual evidence* or *testimonial evidence.* Factual evidence consists of current and historical examples (true incidents), statistics, physical evidence, and facts. Testimonial evidence consists of opinions of experts on the subject being debated. To evaluate testimonial evidence, the debater should ask: "Is this authority an expert and, thus, in a position to know the truth?" and "Is this authority biased, and, thus, in any position to tell the truth?"

Rebuttal. Next, the debaters must select the arguments and evidence of their opponents that they believe can be successfully attacked. Finally, they must prepare their own arguments and evidence that will be used in the attack.

Format. In the *traditional* form of debate, there are two speakers on each side, each of whom makes both a *constructive* speech and a *rebuttal* speech. The speaking order is:

Constructive speeches (10 minutes each)
1. First affirmative
2. First negative
3. Second affirmative
4. Second negative

Rebuttal speeches (5 minutes each)
1. First negative
2. First affirmative
3. Second negative
4. Second affirmative

Another type of debate is the *cross-examination* form, which was developed at the University of Oregon. Each constructive speaker is cross-examined by an opposing speaker. The speaking order is:

Constructive speeches (8 minutes) and
Cross-examinations (3 minutes)
1. First affirmative
2. Cross-examination by second negative

3. First negative
4. Cross-examination by first affirmative
5. Second affirmative
6. Cross-examination by first negative
7. Second negative
8. Cross-examination by second affirmative

Rebuttal speeches (4 minutes)

1. First negative
2. First affirmative
3. Second negative
4. Second affirmative

The decision. If a decision is to be given, one or more judges listen to all the speakers. Each judge decides which team made the most convincing argument and votes for that team. The team with the most votes wins.

Competitive debate. The National Forensic League sponsors debate competitions for high school students. The Cross-Examination Debate Association and the National Debate Tournament Committee of the American Forensic Association sponsor college debate tournaments. James M. Copeland

See also **Lincoln, Abraham** (picture: The Lincoln-Douglas debates); **Logic; Oratory; Public speaking.**

Deborah was a Biblical prophetess of Israel in the period of the Judges, the 1100's B.C. She was the wife of Lapidoth. She acted as an adviser to her people and was a judge in their disputes. Deborah was admired for her wisdom, and she rose to a position of leadership among her people.

When she heard of the cruel treatment her people had received from the Canaanites, Deborah summoned Barak, the Israelite leader. Together they worked out a plan of action for the army of Israel. They hoped to defeat the Canaanite army under Sisera. They fought near Mount Tabor, on the plain of Esdraelon. A rainstorm aided Israel, turning the plain into mud and trapping the enemy chariots. Sisera fled on foot and was later murdered in his sleep. The victory was important in Israel's struggle with the Canaanites. One of the most notable victory odes of the Bible is the *Song of Deborah* in Judges 5. Gary G. Porton

Debrecen, *DEH breh TSEHN* (pop. 217,706), is a commercial and industrial city in eastern Hungary. It serves as a market for nearby farming areas. For location, see **Hungary** (political map). Debrecen became a major center of Protestantism in the 1500's and was called the *Calvinist Rome.* Lajos Kossuth proclaimed Hungarian independence there in 1849. In 1944, during World War II, Hungary's provisional government met in Debrecen. Places of interest in the city include an art gallery, a museum, and a university. Thomas Sakmyster

De Broglie, *duh braw GLEE,* **Louis Victor,** *lwee veek TAWR* (1892-1987), was a French physicist who won the 1929 Nobel Prize in physics for his theory of the wave nature of electrons. This theory became one of the foundations of *quantum mechanics,* a field of physics.

In the 1800's, physicists believed that light consisted of waves of energy. They also thought that all matter was composed of tiny particles that combined in various ways to make up the material world. In the early 1900's, physicists showed that light behaved like particles when emitted or absorbed. These particles of light were called *quanta.* In 1924, de Broglie proposed that, under certain conditions, electrons have characteristics of both particles and waves, as do quanta of light. His theory of matter waves was later verified by experiments.

De Broglie was born in Dieppe, France, and studied at the Sorbonne. He joined the faculty of the University of Paris in 1932. Richard L. Hilt

See also **Quantum mechanics; Physics** (Quantum theory).

Debs, Eugene Victor (1855-1926), was a colorful and eloquent spokesman for the American labor movement and for socialism. He formed the American Railway Union (ARU) in 1893 as an industrial union for all railroad workers. The ARU ordered its members not to move Pullman cars in 1894, in support of a strike by the workers making Pullman cars. President Grover Cleveland used federal troops to break the strike, charging that it interfered with the mails. Debs went to prison for six months in 1895 because he had refused to comply with a federal court order to call off the strike. In 1897, Debs announced that he was a socialist.

During World War I (1914-1918), Debs publicly condemned both war and the U.S. government's prosecution of individuals for *sedition* (inciting rebellion). As a result, he was convicted under the Espionage Law in 1918. He went to prison in 1919, on a 10-year sentence. President Warren G. Harding commuted his sentence in 1921.

Debs ran for the presidency as a socialist candidate five times. He was the nominee of the Social Democratic Party in 1900, and of the Socialist Party in 1904, 1908, 1912, and 1920. Debs ran his 1920 campaign while in prison, but still received nearly 1 million votes.

Debs was born in Terre Haute, Indiana. He became a locomotive fireman and from 1880 to 1893 was national secretary and treasurer of the Brotherhood of Locomotive Firemen and Enginemen. In this period, he organized workers in many occupations. Debs served in the Indiana legislature in 1885. Nick Salvatore

See also **Socialism** (picture).

Additional resources

Constantine, J. Robert, ed. *Gentle Rebel.* Univ. of Ill. Pr., 1995. *Letters of Eugene V. Debs, 1874-1926.* 3 vols. 1991.

Ginger, Ray. *The Bending Cross.* 1949. Reprint. Truman State Univ. Pr., 1992.

Salvatore, Nick. *Eugene V. Debs: Citizen and Socialist.* Univ. of Ill. Pr., 1982.

Debt is anything owed, especially a sum of money that one person owes to another. A person who owes a debt is called a *debtor,* and the one to whom it is owed is the *creditor.* If the debtor is unwilling or unable to pay the debt, the creditor may bring suit to recover the money. If the court finds that the debt is owed, and if the debtor fails to pay, the creditor may appeal to the sheriff for an *execution* of judgment. This gives the creditor the right to seize enough property of the debtor to pay the debt and the costs of the process. But there are exceptions as to what may be seized. This law varies in different states, provinces, and territories.

In a special type of debt called *secured debt,* the debtor promises that, if the debt is not paid on time, the creditor may seize specified property from the debtor before a suit is brought. If the value of the property is not enough to pay the entire debt, the creditor may then sue the debtor for the remaining amount. Most people purchase such expensive items as homes and automo-

biles through secured debt agreements.

Time limits on collection of debts. The courts ordinarily state that debtors should pay their debts, even though the creditor does not demand payment. But if the creditor makes no effort to collect the money within a certain number of years, the debt becomes *barred* by a *statute of limitations* and can no longer be collected.

Penalties for debts. In ancient times, a debtor was handed over to the mercy of his creditors to become a slave. This was true in Greece and Rome, among the Israelites, and among the Saxons in England. During feudal times, however, every man was first of all a soldier, and armies would have broken up if overlords jailed their men for the debts they owed.

As feudalism declined, and trade and industry rose, harsh treatment of debtors was revived. Prison terms were the usual punishment, and thus no money was recovered. Early American settlers included many fugitives from debtors' prisons. John Krahmer

Related articles in *World Book* include:

Attachment
Bankruptcy
Bond
Collection agency
Garnishment
Guaranty
I.O.U.
Moratorium
National debt

Debussy, *dehb yoo SEE,* **Claude** (1862-1918), was an important French composer. His revolutionary treatment of musical form and harmony helped change the direction of music in the early 1900's.

Debussy felt closer to painters and poets than to other musicians, and he acknowledged the influence of literature and painting on his music. He sought a style of composition that was free from conventional musical forms, and he often used descriptive titles. He is regarded as the leader of Impressionism in music, helping create new *tonalities* (relationships among various tones).

Achille-Claude Debussy was born in St.-Germain-en-Laye. He entered the Paris Conservatory at the age of 10. His major works of the late 1800's include the String Quartet in G minor (1893) and the three Nocturnes, the first two for orchestra (1900) and the third (1901) for female voices. The popular piano piece *Rêverie* (1890) is from this period, as is the *Suite bergamasque* (1890, revised 1905). Its third movement, "Clair de Lune," is often played separately. The orchestral *Prelude to "The Afternoon of a Faun"* (1894), based on a poem by Stéphane Mallarmé, pointed to Debussy's later works.

The turning point in Debussy's career came in 1902 with his opera *Pelléas and Mélisande.* Written as a series of short scenes that end without climaxes, the opera emphasizes natural speech as opposed to brilliant singing. In spite of the controversy caused by its unconventional style, the opera was an immediate success and began an extremely productive period for Debussy. His following compositions greatly expanded previous limits of musical structure and tonality. This period lasted about 15 years and included the orchestral masterpieces *La Mer* (1905) and *Images* (1913); the piano works *Estampes* (1903), *Masques* (1904), *L'Isle joyeuse* (1904), two sets of *Images* (1905, 1907), and two books of Préludes (1910, 1913); and several sets of songs.

In 1909, Debussy suffered the first symptoms of cancer. He died of the disease nine years later. Probably because of his illness, he began working at a much slower pace. He started some operas and other large-scale projects but did not finish them.

From 1913 to 1917, Debussy abandoned Impressionism for a more severe, abstract style. He returned to Classicism with three chamber sonatas. They were the sonata for piano and cello (1915); the sonata for flute, violin, and harp (1915); and the sonata for violin and piano (1917). He also composed his most daring works. They include *Syrinx* for solo flute (1913), the 12 Études for piano (1915), and the ballet *Jeux* (1913). Some critics consider the ballet to be Debussy's finest and most influential work. It was first presented by the famous Ballets Russes, which commissioned the score. The choreography was created by the great Russian dancer Vaslav Nijinsky. Stewart L. Ross

See also **Classical music** (The 1900's).

Debye, *deh BY,* **Peter Joseph William** (1884-1966), a Dutch physicist and chemist, won the 1936 Nobel Prize in chemistry for studies of the physical properties of molecules. He was born in Maastricht, the Netherlands. He received a Ph.D. in physics from the University of Munich in 1908. Debye was a pioneer in the field of chemical physics. He came to the United States in 1940. Melvyn C. Usselman

Decaffeinated coffee. See **Coffee** (Kinds of coffee).

Decal, *DEE kal* or *dih KAL,* is the process of transferring printed designs, letters, or pictures from specially prepared paper onto various surfaces. The word *decalcomania* (pronounced *dee KAL kuh MAY nee uh*) also describes this process. The print transferred is called a *decal* or *decal transfer.* Decals can be applied to such surfaces as glass, wood, plastic, and metal. They have many domestic and commercial uses. Manufacturers decorate dishes, furniture, and other products with decals. People use them to decorate toys, windows, and personal items. Decals are also used as automobile licensing stickers on windows because they are difficult to remove.

A decal is made of a thin film of oil paint and lacquer. It is coated on one side with a special adhesive and placed on a paper backing. Some decals can be lifted off the backing and applied directly to an object. Others must be soaked in water to soften the adhesive. The decal is then slid from the backing onto the desired surface. The adhesive dries in about a minute and makes the decal stick.

Decals were developed in Germany in the 1800's. They were first used on dinnerware as a cheaper decorative process than hand painting. Dona Z. Meilach

Decalogue. See **Ten Commandments.**

Decameron. See **Boccaccio, Giovanni.**

Decathlon, *dih KATH lahn,* is a two-day contest in 10 events to determine an all-around track and field champion. Athletes compete in the 100-meter dash, long jump, shot-put, high jump, and 400-meter run, in that order, on the first day. They take part in the 110-meter hurdles, discus throw, pole vault, javelin throw, and 1,500-meter run on the second day. The athletes compete against time and distance standards, instead of against each other. The athlete scoring the most total points wins. The decathlon became a part of the Olympic Games in 1912. Michael Takaha

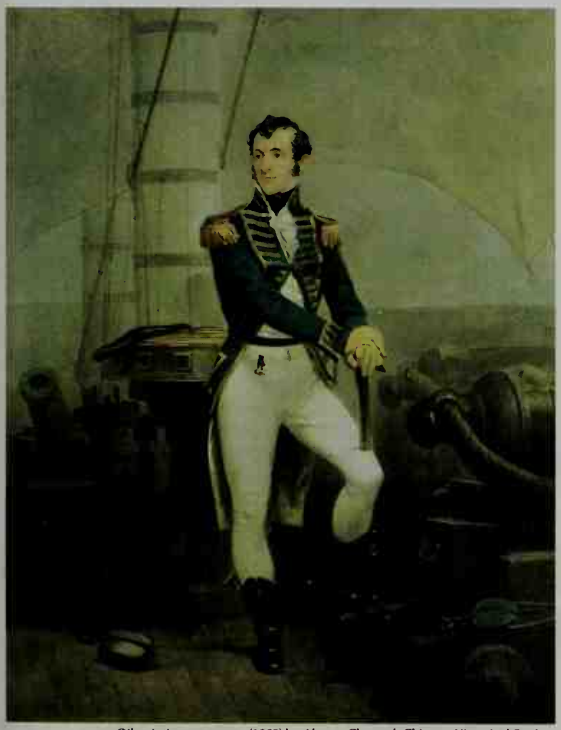
See also **Track and field** (The decathlon, heptathlon, and pentathlon; table: World track and field records).

Decatur (pop. 81,860; met. area pop. 114,706) is an industrial city located in a rich farming region of central Illinois. Decatur lies about 40 miles (64 kilometers) east of Springfield, the state capital. For the location of Decatur, see **Illinois** (political map).

Decatur's major industries process soybeans, make corn products and tires, build tractors and motor graders, and supply automobile manufacturers with parts and equipment. Decatur also has iron and brass foundries. Other factories make compressors, pharmaceuticals, pumps, store fixtures, and water and gas systems. Decatur was settled about 1830. The Grand Army of the Republic was founded there in 1866. The city is the home of Millikin University. Decatur has a council-manager form of government. George T. Althoff

Decatur, Stephen (1779-1820), was one of the most daring officers in the United States Navy during its early years. He is remembered for his toast: "Our country: In her intercourse with foreign nations may she always be right; but our country, right or wrong." Handsome, brave, and honorable, Decatur achieved great popularity with his crews and with the public. He was one of a group of leaders who established the naval traditions of the United States. Others were John Barry, John Paul Jones, David Porter, Oliver Hazard Perry, Thomas Macdonough, and Isaac Hull.

Decatur was born in a log cabin in Sinepuxent, Maryland, on Jan. 5, 1779. He made his first long voyage at the age of 8, when he went to France on a ship commanded by his father, a merchant captain. He became a midshipman in 1798 during the naval war with France and rose to lieutenant in 1799. Given command of the *Enterprise* during the war with Tripoli, he captured an enemy vessel that was renamed the *Intrepid.* In this ship he led a picked band into Tripoli Harbor on the night of Feb. 16, 1804, and set fire to the frigate *Philadelphia,* once commanded by his father, which the Tripoli pirates had captured. Not a man was killed, and only one was wounded. The English Admiral Horatio Nelson is reported to have called this exploit "the most bold and daring act of the age." Because of it, Decatur won a sword from Congress and a captaincy when he was only 25.



Oil painting on canvas (1863) by Alonzo Chappel; Chicago Historical Society

Stephen Decatur stands victoriously on the deck of a man-of-war after successfully forcing Algiers to sign a peace treaty.

Early in the War of 1812, Decatur commanded the U.S. frigate *United States* and captured the British frigate *Macedonian* with little harm to his ship and crew. In 1813, he commanded a squadron of ships in New York, which the British had blockaded in Long Island Sound. Decatur tried to run the blockade in the *President* early in 1815, but his ship struck the sand bar at Sandy Hook and was damaged. He was forced into a fight against heavy odds, was wounded, and surrendered. The British took him prisoner but soon released him.

After the war, Decatur led a squadron against the Barbary States of North Africa, which included most of present-day Algeria, Libya, and Tunisia. Ships from the Barbary States often attacked vessels of other nations in the Mediterranean Sea. Decatur forced the Barbary rulers to release U.S. ships and prisoners and to stop interfering with U.S. vessels. On his return, he became a Navy commissioner. Suspended Commodore James Barron challenged Decatur to a duel in 1820 after Decatur, as a member of a military court, had ruled against Barron. Barron accused Decatur and other officers of persecuting him. Decatur was killed by the commodore near Bladensburg, Maryland. Michael J. Crawford

Decay is the process by which dead animal or dead plant matter is broken down to simple compounds. These simpler products can then be used as food by living things, such as plants. Decay is an important process in the environment. Decay removes the wastes that animals give off and the plants and animals that die. Decay is sometimes called *decomposition* or *putrefaction.*

The major part of the decay process is carried out by microbes, such as bacteria, molds, and yeasts. Such microbes feed on and completely digest dead animal or plant matter, or the waste products of live animals. During decay, enzymes in the microbes break down *macromolecules* (large molecules). For example, the enzymes convert proteins to amino acids and complex carbohydrates to simple sugars. The microbes use these products to build the materials they need. They also use some of the products to get energy for growth and reproduction. As the microbes grow and multiply, the decay process speeds up.

Warmth and moisture help microbes grow and thus assist the decay process. Refrigeration or cooking kills microbes and slows decay. Certain chemicals also can destroy microbes and prevent decay. David Schlessinger

Related articles in *World Book* include:

Antiseptic	Fermentation	Soil
Bacteria	Food preservation	Teeth
Biochemistry	Mold	Yeast
Decomposition	Pasteur, Louis	

Decay series. See Isotope (Radioactive isotopes).

Deceleration. See Motion (Acceleration).

December is the 12th and last month of the year according to the Gregorian calendar, which is used in almost all the world today. It was the 10th month in the early Roman calendar and takes its name from the Latin word *decem,* which means *ten.* It became the 12th month in a later Roman calendar. In 46 B.C., the Roman statesman Julius Caesar added two days to December, which before then had only 29 days. In the Northern Hemisphere, the winter solstice occurs on December 21 or 22. The solstice is the longest night of the year and marks the official start of winter. The December solstice is known as the summer solstice in the Southern Hemisphere, occurring on the longest day of the year and marking the beginning of summer.

The time near the winter solstice has long been a time of celebration. In Sweden, the Feast of Santa Lucia marks the start of the Christmas season. This festival is a celebration of light. The ancient Romans celebrated Saturnalia in mid-December with feasting, parties, and gift giving. The festival honored Saturn, the Roman god of agriculture. In Finland, people gather for parties known as Pikkujoulu (Little Christmas) starting in early December.

Christmas Day, December 25, is the chief holiday of the month in many countries today. Christians celebrate it as the birthday of Jesus Christ. The date of the celebration may have been set near the solstice to counter pagan celebrations that occurred at that time of year. On this day, many people go to religious services and exchange gifts. In many countries, including Australia, Canada, New Zealand, and the United Kingdom, the day following Christmas is called Boxing Day. The holiday may date from the Middle Ages when priests opened the church's *alms* (charity) boxes on the day after Christmas and distributed the contents to the poor. Or it may have begun with lords and ladies in England, who presented Christmas gifts in boxes to their servants on December 26. In the Bahamas, the Junkanoo celebration

Important December events

2 United States President James Monroe proclaimed the Monroe Doctrine in his message to Congress, 1823.
— John Brown, American abolitionist, hanged in 1859.
— Scientists in Chicago achieved the first controlled atomic chain reaction, 1942.
3 Illinois became the 21st U.S. state, 1818.
— Joseph Conrad, British novelist, born in Poland in 1857.
— Maria Callas, opera singer, born in United States in 1923.
— Christiaan Barnard, South African surgeon, performed the first human heart transplant in 1967.
— Poisonous gas leaked from a pesticide plant, killing over 2,800 people at Bhopal, India, 1984.
4 Saint Barbara's Day, France and central Europe.
— Thomas Carlyle, Scottish author, born 1795.
5 Sinterklaas Day, Netherlands.
— Phi Beta Kappa, honorary scholastic society, founded at the College of William and Mary, Virginia, 1776.
— Martin Van Buren, eighth U.S. president, born 1782.
— Walt Disney, American movie producer, born 1901.
— Amendment 21 to the United States Constitution, repealing Prohibition, proclaimed in 1933.
6 Feast of Saint Nicholas in Europe.
— Finland declared independence from Russia in 1917.
— Columbus discovered Hispaniola, 1492.
7 Delaware ratified the U.S. Constitution, 1787.
— Japan attacked Pearl Harbor in World War II, 1941.
8 Horace, Roman poet, born 65 B.C.
— Eli Whitney, American inventor, born 1765.
— Jean Sibelius, Finnish composer, born 1865.
— American Federation of Labor organized, 1886.
— Chinese Nationalists fled to Formosa (today Taiwan), 1949.
— John Lennon shot and killed in New York City, 1980.
9 Independence Day, Tanzania.
— John Milton, English poet, born 1608.
— Joel Chandler Harris, American author, born 1848.
10 Constitution Day, Thailand.
— William Lloyd Garrison, American journalist and abolitionist, born 1805.
— Mississippi became the 20th U.S. state, 1817.
— Emily Dickinson, American poet, born 1830.
— Territory of Wyoming authorized women to vote and hold office, 1869.
— Spain ceded the Philippines to the United States, 1898.
11 Hector Berlioz, French composer, born 1803.
— Indiana became the 19th U.S. state, 1816.
— Robert Koch, German bacteriologist, born 1843.
— Edward VIII of United Kingdom gave up throne, 1936.
12 Kenya became independent in 1963.
— John Jay, American diplomat, born 1745.
— Pennsylvania ratified the U.S. Constitution, 1787.
— Gustave Flaubert, French novelist, born 1821.
— Guglielmo Marconi received the first radio signal sent across the Atlantic Ocean, 1901.
13 Feast of Santa Lucia in Scandinavian countries.
— The Council of Trent opened, 1545.
— Sir Francis Drake left England to sail around the world, attacking Spanish possessions, 1577.
14 Tycho Brahe, Danish astronomer, born 1546.
— George Washington died at Mount Vernon, Virginia, 1799.
— Alabama became the 22nd U.S. state, 1819.
— James Doolittle, American flier, born 1896.
— Roald Amundsen, Norwegian explorer, reached the South Pole in 1911.
15 First 10 amendments to the U.S. Constitution, known together as the Bill of Rights, ratified 1791.
— Maxwell Anderson, American playwright, born 1888.

Dec. birthstone—turquoise

Dec. flower—poinsettia

Dec. 7—Japanese attack on Pearl Harbor

Dec. 10—Emily Dickinson born

and parade is held on Boxing Day and again on New Year's Day.

The Jewish holiday Hanukkah usually falls in December. Hanukkah is also known as "The Festival of Lights." The holiday recalls the miracle of the lamp burning in the Temple for eight days with only enough oil for one day when the Temple was rededicated in 165 B.C., after the Jews successfully overthrew their Syrian rulers. A relatively new holiday, Kwanzaa, originated in the United States and is celebrated from December 26 to January 1. This African American holiday is a celebration of family, ancestors, and the harvest. The Sikh observation of the birth of Gobind Singh, the 10th and last of the Sikh *gurus* (teachers), falls on December 31. The last day of December is also New Year's Eve, when, at midnight, a new year is ushered in.

Holly, narcissus, and poinsettia are the flowers associated with December. The turquoise and the zircon are December birthstones. Carole S. Angell

Quotations

The sun that brief December day
Rose cheerless over hills of gray,
And, darkly circled, gave at noon
A sadder sight than waning moon.
John Greenleaf Whittier

I heard the bells on Christmas Day
Their old, familiar carols play,
And wild and sweet
The words repeat
Of peace on earth, good will to men.
Sir Walter Scott

Related articles in *World Book* include:

Boxing Day
Calendar
Christmas
Hanukkah
Holly
Kwanzaa
Solstice
Turquoise

Important December events

16 National Day, Bahrain.
— English Parliament passed Bill of Rights, 1689.
— Ludwig van Beethoven, German composer, born 1770.
— Boston Tea Party, 1773.
— Jane Austen, English novelist, born 1775.
— Noel Coward, British actor and playwright, born 1899.
— Margaret Mead, American anthropologist, born 1901.
— Bijoy Dibash (Victory Day) marks victory of Bangladesh in its war for independence against Pakistan in 1971.
17 Sir Humphry Davy, English chemist, born 1778.
— John Greenleaf Whittier, American poet, born 1807.
— William Lyon Mackenzie King, prime minister of Canada, born 1874.
— Orville Wright made first heavier-than-air flight at Kitty Hawk, North Carolina, 1903.
18 Republic Day, Niger.
— Charles Wesley, English clergyman, born 1707.
— New Jersey ratified the U.S. Constitution, 1787.
— Amendment 13 to the U.S. Constitution, ending slavery, proclaimed 1865.
— Christopher Fry, British playwright, born 1907.
19 Continental Army camped for the winter at Valley Forge, Pennsylvania in 1777, during the American Revolution.
20 The United States took over Louisiana, 1803.
21 The Pilgrims landed at Plymouth, Massachusetts, 1620.
— Jean Baptiste Racine, French playwright, born 1639.
— Benjamin Disraeli, prime minister of the United Kingdom, born 1804.
— Joseph Stalin, Soviet dictator, born 1879.
22 Giacomo Puccini, Italian opera composer, born 1858.
23 Richard Arkwright, British inventor, born 1732.
— U.S. Federal Reserve System established, 1913.
24 Libya became independent in 1951.
— Kit Carson, American frontier scout, born 1809.
— United States and United Kingdom signed the Treaty of Ghent in 1814, ending the War of 1812.
25 Christians celebrate Christmas as the birth of Jesus Christ.
— Isaac Newton, English scientist, born 1642.
— George Washington and his men started across the Delaware River to New Jersey in American Revolution, 1776.
— Clara Barton, "Angel of the Battlefield" and founder of the American Red Cross, born 1821.
— The Soviet Union was dissolved, 1991.
26 Boxing Day in various countries.
— Junkanoo celebration and parade, Bahamas.
— Saint Stephen's Day, Czech Republic and Slovakia.
— Battle of Trenton in the American Revolution, 1776.
— George Dewey, American admiral, born 1837.
— Mao Zedong, Chinese leader, born 1893.
27 Johannes Kepler, German astronomer, born 1571.
— Louis Pasteur, French chemist, born 1822.
— Sir Mackenzie Bowell, prime minister of Canada, born 1823.
28 Holy Innocents' Day, western Europe and Mexico.
— Iowa became the 29th U.S. state, 1846.
29 Saint Thomas Becket murdered at Canterbury, England, 1170.
— Andrew Johnson, 17th U.S. president, born 1808.
— William E. Gladstone, British prime minister, born 1809.
— Texas became the 28th U.S. state, 1845.
— Woodrow Wilson, 28th U.S. president, born 1856.
30 The United States acquired territory from Mexico in the Gadsden Purchase, 1853.
— Rudyard Kipling, British writer, born 1865.
31 Andreas Vesalius, Flemish anatomist, born 1514.
— Guru Gobind Singh, 10th and final Sikh guru, born 1666.
— Henri Matisse, French painter, born 1869.

WORLD BOOK illustrations by Mike Hagel

Dec. 14—Roald Amundsen reached South Pole

Dec. 17—first flight by Orville Wright

Dec. 21—Pilgrims' arrival at Plymouth

Dec. 25—Clara Barton born

Decembrist Uprising. See Russia (Alexander I).
Decemvirs. See Twelve Tables, Laws of the.
Decibel, *DEHS uh behl,* is a unit used to measure levels of sound, electric power, and related quantities. Its symbol is dB. A decibel equals one-tenth of a *bel,* a unit named for Scottish-born inventor and educator Alexander Graham Bell.

The softest sound that most people can hear has a level of about 0 dB. Normal conversation takes place at a level of 60 dB. Extremely loud music might measure 120 dB—and listening to such music for a long time could cause hearing loss. A level of 140 dB, perhaps from a jet aircraft taking off nearby, can produce pain.

Decibels represent differences in *sound intensity*—that is, in sound power per unit of area. Each increase of 10 decibels represents a tenfold increase in power. Thus, for example, a 50-dB sound source delivers 10 times as much power to an area on the surface of the eardrum as a 40-dB source delivers, a 60-dB source delivers 100 times the power of a 40-dB source, and so on. Mathematically, the differences work out such that a doubling of power produces an increase of 3.01 dB.

Normal sound waves carry little power, as the following definition and example will show. Sound intensity can be defined as the rate of transmission of sound energy through a certain curved area of space. This area is a section of the surface of an imaginary sphere surrounding the sound source. Suppose you were listening to a radio that was about 10 feet (3 meters) in front of you. You might consider the radio to be in the center of an imaginary sphere that had a radius of about 10 feet. Your ears would be on the surface of the sphere. Suppose the radio were playing loudly, delivering a sound of 90 dB to your ears. The sound intensity would be only $\frac{1}{1000}$ of a watt per square meter of surface area of the sphere.

Electrical engineers sometimes measure power and voltage in decibels. In power measurements, a doubling of power produces a gain of 3.01 dB—as in sound measurements. However, the decibel scale for voltage measurements has a different mathematical basis: A doubling of voltage produces a gain of 6.02 dB. Ken C. Pohlmann

See also Sound (Intensity and loudness).

Deciduous tree, *dih SIHJ u uhs,* is the name for any tree that loses its leaves at a certain time each year and later grows new leaves. In northern temperate regions, most deciduous trees lose their leaves in the autumn. The twigs and branches stay bare all winter. The following spring the trees grow a new set of green leaves. Before the leaves die, some of the food material they contain is drawn back into the twigs and branches. There it is stored and used the following spring. Deciduous trees usually have broad leaves. Such trees include ash, beech, birch, maple, and oak. Larch is a common deciduous tree that has needlelike leaves.

Dried leaves continue to hang on the branches of some deciduous trees until the new leaves come out. In warmer climates, deciduous trees grow new leaves earlier in the spring and retain their leaves longer.

Scientists think that losing the leaves helps some trees to conserve water in the winter. Water normally passes into the air from tree leaves by a process called *transpiration.* Richard C. Schlesinger

See also Tree (Broadleaf trees).

Decimal numeral system. See Decimal system.
Decimal system is a way of writing numbers. Any number, from huge quantities to tiny fractions, can be written in the decimal system using only the 10 basic symbols 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0. The value of any of these symbols depends on the place it occupies in the number. The symbol 2, for example, has different values in the numbers 832 and 238, because the 2 is in different places in the numbers. Because the value of a symbol depends on where it is in a number, the decimal system is known as a *place-value system.*

The word *decimal* comes from *decem,* the Latin word for *ten.* The decimal system received its name because it is a *base-ten system.* The value of each place is 10 times greater than the value of the place just to its right. Thus, the symbols on the left of a number have larger values than symbols farther to the right. For example, the symbol 2 in 238 is worth much more than the symbol 2 in 832, because the 2 in 238 is farther to the left than is the 2 in 832.

The decimal system is also called the *Hindu-Arabic system.* It was developed by Hindu mathematicians in India more than 2,000 years ago. Arabs learned this system after conquering parts of India in the A.D. 700's. They spread knowledge of the system throughout their empire, including the Middle East, northern Africa, and Spain.

The decimal system and number words

In the English language, special number words are used to name the value of each place in the decimal system except the *ones place* (the place farthest to the right). The letters "ty" at the end of the words for numbers in the second place (just left of the ones place) indicate the number of tens. For example, *sixty* means *six tens.* The word *hundred* is used to show the size of the third place. There is another new word for the fourth place, *thousand,* but after that there are only new words for every third place to the left.

A comma is placed after each third place in order to make it easier to read a decimal system number. The words *ten* and *hundred* are used with *thousand* and the other special words to name all the places between the special places. Each group of three numbers is read as if

Some large decimal system numbers

Number word	How many	Written in the decimal system	Written in exponents
Thousand	one thousand	1,000	10^3
Million	one thousand thousands	1,000,000	10^6
Billion	one thousand millions	1,000,000,000	10^9
Trillion	one thousand billions	1,000,000,000,000	10^{12}
Quadrillion	one thousand trillions	1,000,000,000,000,000	10^{15}

The names for the next thousands are quintillion, sextillion, septillion, octillion, nonillion, decillion, undecillion, duodecillion, tredecillion, quattuordecillion, quindecillion, sexdecillion, septendecillion, octodecillion, novemdecillion, and vigintillion. In Australia and the United Kingdom, the word *billion* refers to a million millions rather than to a thousand millions. *Trillion* refers to a million billions, and so on.

it had only three places, and then the name of its group is added. For example, in the United States and Canada, the number 5,246,380,901,483 is read as "five trillion, two hundred forty-six billion, three hundred eighty million, nine hundred one thousand, four hundred eighty-three."

Large numbers in the decimal system can easily be expressed using *exponents*. An exponent is a symbol written to the right of and above a number. The exponent tells how many times a number is used as a *factor*. For example, the figure 10^6 is equivalent to the expression $10 \times 10 \times 10 \times 10 \times 10 \times 10$, in which 10 appears as a factor six times. Because multiplying by 10 moves a number written in the decimal system over one place to the left, the exponent for ten also tells how many zeros to write when that number is written in the decimal system. Thus, 10^6 is written as a 1 followed by six zeros—1,000,000.

Decimals less than one

In the decimal system, as the places go to the left of the ones place, each place gets ten times larger than the last. But the places can also go to the right of the ones place. As places go to the right, the values of those places get smaller. In the first place to the right, the one is divided into ten equal parts, called *tenths*. In the second place to the right, each tenth is itself divided into ten parts. As a result, in this place, the one has been divided into ten times ten—or one hundred—small parts. Each of these small parts, called *hundredths*, gets divided into ten smaller parts in the third place, and so on.

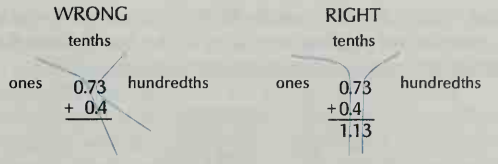
The names for the places to the right are like those for the places to the left, except that the letters "th" are added to the name for each place. The names for the places to the right sound as if the values are getting bigger, but the "th" shows that the values are really getting smaller. It takes only ten tenths to make one, but it takes a million millionths to equal one.

A period, called the *decimal point*, is written between the ones place and the first small decimal place to show when a decimal system number includes the small places to the right of the ones place. When a decimal system number does not include any places to the right of the ones place, a period does not have to be written. The period is usually read as "and" to show that the smaller places are starting. For example, 345.678 is read as "three hundred forty-five and six hundred seventy-eight thousandths." To name the places to the right, read the numbers as if they were to the left of the decimal point and then add the name of the place farthest to the right. The places in the decimal system are *symmetric* (balanced) around the ones place, not around the decimal point:

hundreds tens ones .tenths hundredths

Addition and subtraction of decimals smaller than one are done in the same way as addition and subtraction of whole numbers. Only numbers in the same places can be added or subtracted. One number is written beneath the other number so that matching places line up—that is, tenths are beneath tenths, hundredths beneath hundredths, and so on.

To add or subtract numbers with decimals less than one, write one number beneath the other number so that the decimal point of the bottom number is beneath



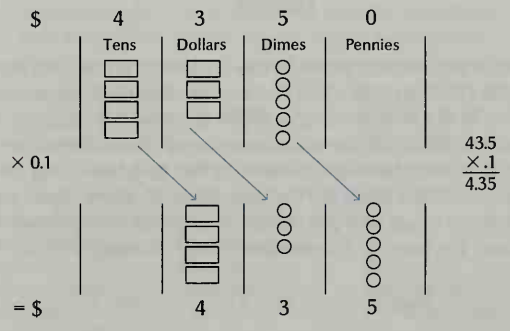
the decimal point of the top number. It does not matter if one number has numerals sticking out to the right or left of the other number. You can put in zeros in any places that are missing numerals. Then add or subtract the numerals that are just above and below each other.

7 − 2.61	.356 + 27.9	548 − 6.08
7.00	.356	548.
−2.61	+27.9	− 6.08
4.39	28.256	541.92

Multiplication of one whole number by another gives a number larger than the original number. But multiplication of a number by a decimal less than one gives a number *smaller* than the original number.

2×3 means two groups of three
$.1 \times 3$ means .1 group of three, or one-tenth of three, which is just part of three

The multiplication shift rule for multiplying a number by .1 (one-tenth) is that each digit moves one place to the right—that is, it moves one place smaller.



In this example, the amount $43.50 consists of four ten-dollar bills, three one-dollar bills, and five dimes. When multiplied by .1, each of the five dimes becomes a penny, because a penny is a tenth of a dime. Each of the three dollars becomes a dime, because a dime is one-tenth of a dollar. One-tenth of ten dollars is a dollar, so each of the 4 tens becomes a one. So the $43.50 becomes $4.35.

The multiplication shift rule for multiplying a number by .01 (one-hundredth) states that each digit in the number moves two places to the right. Each digit in a number multiplied by .001 (one-thousandth) moves three places to the right, and so on. In general, when a number is multiplied by any decimal smaller than one, the number moves as many places to the right as there are places smaller than one. Therefore, the rule for multiplying any number by a decimal number is: Multiply as

usual. Then add the number of decimal places in the top number to the number of places in the bottom number and put that many decimal places in the answer.

27.5	one place
× .03	two places
.825	three places

In this example, there is one decimal place in the top number. Multiplying this number by .03 will move the number over two more places to the right. So there will be 1 + 2 decimal places in the answer.

Division of a number by a decimal number smaller than one means finding out how many of those small decimal parts there are in that number. In problems involving the division of a whole number by a decimal smaller than one, the answer is always *larger* than the number being divided.

6 ÷ 2 means "How many twos in six?"

6 ÷ .1 means "How many tenths in six?"

Asking how many tenths there are in six is similar to asking "How many dimes in six dollars?" There are ten dimes in one dollar, so there are 6 × ten (60) dimes in six dollars. Therefore, 6 ÷ .1 = 60.

The division shift rule for tenths is just the opposite of the multiplication shift rule for tenths. Each place in the number being divided shifts one place to the *left* (gets one place larger). When a number is divided by .01 (one-hundredth), each place moves two places to the left, and so on.

To divide by a number with places smaller than one, write the problem in long division form.

$$1.08\overline{)75.6}$$

Move the decimal point in the divisor all the way to the right. Write a caret mark (^) for this new decimal place. Then in the number being divided, move the decimal point to the right *the same number of places.* Write zeros if more spaces are needed in the number being divided. Write a caret for the new decimal place. Then just divide as usual and put the decimal point in the answer above the caret in the number being divided.

Step 1	Step 2	Step 3
$1.08\overline{)75.6}$	$1.08\overline{)75.60}$	$1.08\overline{)75.60}$ with 70 above, 756, 00

This rule works because you are just multiplying the problem by 1, which will not change the answer:

$$\frac{75.6}{1.08} = \frac{75.6}{1.08} \times 1 = \frac{75.6}{1.08} \times \frac{100}{100} \times \frac{7560}{108} = 70$$

Decimals and fractions

In mathematics, any number that can be written in the form of a fraction—that is, as one number divided by another—is called a *rational number.* All rational numbers can be written in the decimal system. When rational numbers are changed to the decimal form, the result is either a *repeating decimal* or a *terminating decimal.* A repeating decimal is one that goes on repeating the same number or series of numbers, such as 0.333 ... and 0.14851485. ... The dots at the end show that the same pattern repeats over and over. This repetition may also be shown by writing a bar line above the repeating pattern: $0.\overline{3}$ and $0.\overline{1485}$. A terminating decimal is one in which the division at some point comes out even and so the decimal number stops.

Any repeating or terminating decimal can be written as a rational number—that is, in fraction form. But some decimal numbers, called *irrational numbers,* never repeat or end and cannot be written in rational form. Two examples of irrational numbers are $\sqrt{2}$ and pi (π). The symbol $\sqrt{2}$ represents the square root of two. This is the number which when multiplied times itself gives two. It is between 1.4142135 and 1.4142136. Pi is the number you get when you divide the *circumference* (the distance around) of any circle by its *diameter* (the distance across it through its center). The value of pi is between 3.1415926 and 3.1415927. See **Circle; Pi.**

Changing fractions to decimals. To change a number from the fraction form to the decimal form, carry out the division that is implied in the fraction. Divide the *numerator* (top number) by the *denominator* (bottom number). This division will always give either a terminating decimal or a repeating decimal, because the remainder will eventually be 0 or will repeat an earlier remainder. A repeating decimal can be rounded off to any place.

Terminating decimal

$\frac{3}{5} \rightarrow 5\overline{)3.0}$ (0.6; 3.0; 0) so $\frac{3}{5} = .6$

Repeating decimal

$\frac{2}{3} = 3\overline{)2.000}$ (0.666...; 18; 20; 18; 20; 18; 2)

Changing decimals to fractions. To change a decimal to a regular fraction, write the number without any decimal point as the top of the regular fraction. For the bottom of the regular fraction, write the numeral 1 followed by as many zeros as there are places to the right of the decimal point in the decimal. This bottom number is the value of the last place in the decimal.

$0.28 = \frac{28}{100}$ — hundredths place; two places → two zeros

$0.005 = \frac{5}{1000}$ — thousandths place; three places → three zeros

The exact procedure for changing a repeating decimal to a fraction varies with the form of the repeating decimal. If the repeating decimal starts in the tenths place and has no whole numbers in it, the fraction form of the repeating decimal has the repeating pattern as the top number and as many 9's as there are places in the repeating pattern for the bottom number.

$$0.\overline{581} = \frac{581}{999} \qquad 0.\overline{4628} = \frac{4628}{9999} \qquad 0.\overline{14} = \frac{14}{99}$$

In some repeating decimals, there are nonrepeating numbers before the pattern of the decimal starts repeating. If these nonrepeating numbers are whole numbers,

the top number for the new fraction is made by writing the repeating decimal up to the first repeat of the pattern and subtracting from this the whole number. The bottom number is as many 9's as there are in the repeating pattern.

$$25.\overline{639} = \frac{25639 - 25}{999} = \frac{25614}{999}$$

In some repeating decimals, the nonrepeating numbers are to the right of the decimal point. In such cases, the top number is made by writing the nonrepeating part followed by one repeat of the pattern. The nonrepeating part is then subtracted from this number. The bottom number is made by writing as many 9's as there are places in the repeating pattern, followed by as many 0's as there are nonrepeating places to the right of the decimal point.

$$.74\overline{5} = \frac{745 - 74}{900} = \frac{671}{900}$$

$$5.\overline{1693} = \frac{51693 - 51}{9990} = \frac{51642}{9990}$$

History

Invention of the decimal system. The decimal system was invented in India, but no one knows exactly when or where. As early as 250 B.C., a base-ten number system was written in Brahmi, a script used for writing the Sanskrit language. The Hindu-Arabic numerals 1, 2, 3, 4, 5, 6, 7, 8, and 9 are based on the Brahmi symbols for the numbers one through nine. However, the Brahmi number system also used special symbols for ten, twenty, thirty, forty, fifty, sixty, seventy, eighty, ninety, one hundred, and one thousand.

By A.D. 595, all the extra symbols had been dropped from the system. All numbers were written by using just the symbols for one through nine. The place in which a symbol was written told its value. However, there was a problem with this place-value system. If a given place was empty, some new symbol was needed to hold that place empty so that all the other symbols would stay in their correct places. The first record of the use of such a new symbol in the Brahmi system is from A.D. 876. This symbol is what we now call zero. The Maya of Central America, who also invented a place-value system, used a zero before A.D. 300 (see **Zero**).

Spread of the decimal system. During the 700's, Arabs conquered parts of India. They learned the decimal system there, and during the next 300 years, spread it throughout their empire—through the Middle East to northern Africa, and into Spain.

The system was introduced into Europe by several people, including Pope Sylvester II about 1000 and Leonardo Fibonacci, an Italian mathematician, in 1202. At that time, however, new learning in books did not reach large numbers of people, chiefly because books were copied by hand and were therefore scarce. But soon after the printing press was invented in the mid-1400's, several arithmetic books that explained the use of the decimal system were published in England, France, Germany, the Netherlands, and other countries. Schools opened in many countries to teach decimal-system calculations, and the system was taught in universities.

The widespread interest in the decimal system was due largely to the number of advantages the system had over Roman numerals, which most people in Europe used at the time (see **Roman numerals**). Calculations are difficult with Roman numerals, so people used little round pieces of metal as counters. They performed their calculations with such devices as calculating boards or calculating cloths that had vertical columns drawn on them to make places for the counters. But because of the place-value nature of the decimal system, calculations could be performed with decimal numbers by using just a pen and paper. It also takes less space to write a number in the decimal system. Larger numbers can be written without new symbols. Another advantage is that numbers smaller than one can be written in the decimal system, and these numbers can be used in calculations.

Use of decimals smaller than one. The first books written in Europe about the decimal system did not say anything about decimals smaller than one. Such decimals were used in China many centuries before they were introduced into Europe and were used by Arab astronomers by at least the early 1400's. Some European mathematicians and astronomers had also known about decimals smaller than one, but the first evidence of their use by merchants and ordinary people appeared in a Flemish pamphlet called *De Thiende*, published in the Netherlands in 1585. John Napier, a Scottish baron who studied mathematics, published in 1619 an easier way to write decimals smaller than one, and we still use his method today. Such decimals gradually began to be used with the rest of the decimal system.

In the late 1700's, France adopted a metric system of weights and measures and a new money system. Both were based on the decimal system (see **Metric system**). They enabled many more people to use decimals less than one. By the late 1900's, nearly every country had converted, or planned to convert, to the metric system.

The importance of decimals smaller than one was further increased in the late 1970's and early 1980's by the development of inexpensive electronic calculators. Many problems that were previously solved with fractions could be done more easily with calculators that use the decimal system. Karen Connors Fuson

Related articles in *World Book* include:

Abacus	Metric system	Percentage
Arabic numerals	Numeration systems	Rational number
Arithmetic		Scientific notation
Fraction		

Declaration of Human Rights. See Human Rights, Universal Declaration of.

Declaration of Independence is the historic document in which the American Colonies declared freedom from Britain. The Second Continental Congress, a meeting of delegates from the colonies, adopted the Declaration on July 4, 1776. This date has been celebrated ever since as the birthday of the United States.

The Declaration of Independence eloquently expressed the colonies' reasons for rejecting British rule. Its stirring opening paragraphs stated that the people of every country have the right to change or overthrow any government that violates their essential rights. The remainder listed ways the British government had violated American rights. The ideas expressed so majestically in the Declaration have long inspired the pursuit of freedom and self-government throughout the world.

Events leading to the Declaration. During the 10-year period prior to the adoption of the Declaration, American leaders repeatedly challenged the British Parliament's right to tax the colonies. Three efforts by Parliament to raise taxes provoked heated protest from the colonists. These efforts were the Stamp Act of 1765, the Townshend Acts of 1767, and the Tea Act of 1773.

The Stamp Act required colonists to pay for tax stamps placed on newspapers, playing cards, diplomas, and various legal documents. Colonial resistance forced Parliament to repeal the act in 1766. The Townshend Acts placed *duties* (taxes) on imported goods. The colonists reacted by boycotting British goods, which hurt British businesses. In 1770, Parliament removed the duties on all items except tea. The Tea Act made British tea cheaper than tea the colonists had been smuggling into the colonies. The British hoped the colonists would purchase the British tea at the lower price, and thereby acknowledge Britain's right to tax them. But the residents of Boston defied the act by dumping hundreds of pounds of British tea into Boston Harbor. This event became known as the Boston Tea Party.

In 1774, Parliament responded to the Boston Tea Party by adopting laws that closed the port of Boston and gave the British-appointed governor of Massachusetts more power. In addition, the laws allowed British officials accused of crimes against Americans to be returned to Britain for trial. Angry colonists referred to these laws as the Intolerable Acts or the Coercive Acts.

The Continental Congress. The Intolerable Acts alarmed the colonists. On Sept. 5, 1774, the First Continental Congress met in Philadelphia to plan common measures of resistance. All the colonies except Georgia sent representatives to the Congress. The delegates supported the view held by most colonists—that they could not be ruled by a Parliament in which they were not represented. The most Parliament could do, the delegates suggested, was pass laws regulating the trade of the British Empire. Most colonists still wanted to remain members of the empire, but they felt they owed allegiance only to the British Crown and not to Parliament. The delegates to the First Continental Congress hoped Britain's King George III and his ministers would free the colonies from the Intolerable Acts.

In 1775, most colonists still did not favor declaring themselves independent of the British Crown. Such a declaration would cut the last bond linking the colonies to Britain. The delegates to the Second Continental Congress, which assembled on May 10, 1775, continued to hope the king would help resolve the colonists' differences with Parliament. In July, the colonists sent a final petition to Britain declaring their loyalty to the king and asking him to address their complaints. But the king ignored their request and declared the colonies to be in rebellion.

Meanwhile, the Revolutionary War had begun in April 1775, when British troops clashed with colonial militia at Lexington, Mass., and nearby Concord. In January 1776, the political writer Thomas Paine published *Common Sense*. This electrifying pamphlet attacked the concept of monarchy and made a powerful case for the independence of the American Colonies.

As the fighting intensified, hopes of reconciliation with Britain faded. On June 7, 1776, Richard Henry Lee of Virginia introduced a resolution to the Second Continental Congress stating that "these United Colonies are, and of right ought to be, free and independent States . . ." After several days of debate, the Congress appointed a committee to draft a declaration of independence. The committee gave the task to Thomas Jefferson of Virginia, who completed the work in about two weeks. Two other members, Benjamin Franklin of Pennsylvania and John Adams of Massachusetts, made a few minor changes.

Adoption of the Declaration. On July 2, the Congress approved the Lee resolution. The delegates then began to debate Jefferson's draft. A few passages, including one condemning King George for encouraging the slave trade, were removed. Most other changes dealt with style. On July 4, the Congress adopted the final draft of the Declaration of Independence.

The Declaration was signed by John Hancock as president of the Second Continental Congress and by Charles Thomson, the Congress's secretary. It was

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Signers of the Declaration of Independence

Fifty-six members of the Continental Congress signed the engrossed parchment copy of the Declaration. Most members signed on Aug. 2, 1776. The rest signed on later dates. *World Book* has a biography of each signer. The signers, in alphabetical order, were:

John Adams (Mass.)
Samuel Adams (Mass.)
Josiah Bartlett (N.H.)
Carter Braxton (Va.)
Charles Carroll (Md.)
Samuel Chase (Md.)
Abraham Clark (N.J.)
George Clymer (Pa.)
William Ellery (R.I.)
William Floyd (N.Y.)
Benjamin Franklin (Pa.)
Elbridge Gerry (Mass.)
Button Gwinnett (Ga.)
Lyman Hall (Ga.)
John Hancock (Mass.)
Benjamin Harrison (Va.)
John Hart (N.J.)
Joseph Hewes (N.C.)
Thomas Heyward, Jr. (S.C.)
William Hooper (N.C.)
Stephen Hopkins (R.I.)
Francis Hopkinson (N.J.)
Samuel Huntington (Conn.)
Thomas Jefferson (Va.)
Francis Lightfoot Lee (Va.)
Richard Henry Lee (Va.)
Francis Lewis (N.Y.)
Philip Livingston (N.Y.)
Thomas Lynch, Jr. (S.C.)
Thomas McKean (Del.)
Arthur Middleton (S.C.)
Lewis Morris (N.Y.)
Robert Morris (Pa.)
John Morton (Pa.)
Thomas Nelson, Jr. (Va.)
William Paca (Md.)
Robert T. Paine (Mass.)
John Penn (N.C.)
George Read (Del.)
Caesar Rodney (Del.)
George Ross (Pa.)
Benjamin Rush (Pa.)
Edward Rutledge (S.C.)
Roger Sherman (Conn.)
James Smith (Pa.)
Richard Stockton (N.J.)
Thomas Stone (Md.)
George Taylor (Pa.)
Matthew Thornton (N.H.)
George Walton (Ga.)
William Whipple (N.H.)
William Williams (Conn.)
James Wilson (Pa.)
John Witherspoon (N.J.)
Oliver Wolcott (Conn.)
George Wythe (Va.)

IN CONGRESS, JULY 4, 1776.

The unanimous Declaration of the thirteen united States of America,

When in the course of human events it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation. We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed, — That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or to abolish it, and to institute new Government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happiness. Prudence, indeed, will dictate that Governments long established should not be changed for light and transient causes; and accordingly all experience hath shewn, that mankind are more disposed to suffer, while evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed. But when a long train of abuses and usurpations, pursuing invariably the same Object evinces a design to reduce them under absolute Despotism, it is their right, it is their duty, to throw off such Government, and to provide new Guards for their future security. — Such has been the patient sufferance of these Colonies; and such is now the necessity which constrains them to alter their former Systems of Government. The history of the present King of Great Britain is a history of repeated injuries and usurpations, all having in direct object the establishment of an absolute Tyranny over these States. To prove this, let Facts be submitted to a candid world. — He has refused his Assent to Laws, the most wholesome and necessary for the public good. — He has forbidden his Governors to pass Laws of immediate and pressing importance, unless suspended in their operation till his Assent should be obtained; and when so suspended, he has utterly neglected to attend to them. — He has refused to pass other Laws for the accommodation of large districts of people, unless those people would relinquish the right of Representation in the Legislature, a right inestimable to them and formidable to tyrants only. — He has called together legislative bodies at places unusual, uncomfortable, and distant from the depository of their Public Records, for the sole purpose of fatiguing them into compliance with his measures. — He has dissolved Representative Houses repeatedly, for opposing with manly firmness his invasions on the rights of the people. — He has refused for a long time, after such dissolutions, to cause others to be elected; whereby the Legislative powers, incapable of Annihilation, have returned to the People at large for their exercise; the State remaining in the mean time exposed to all the dangers of invasion from without, and convulsions within. — He has endeavoured to prevent the population of these States; for that purpose obstructing the Laws for Naturalization of Foreigners; refusing to pass others to encourage their migrations hither, and raising the conditions of new Appropriations of lands. — He has obstructed the Administration of Justice, by refusing his Assent to Laws for establishing Judiciary powers. — He has made Judges dependent on his Will alone, for the tenure of their offices, and the amount and payment of their salaries. — He has erected a multitude of New Offices, and sent hither swarms of Officers to harass our People, and eat out their substance. — He has kept among us, in times of peace, Standing Armies without the Consent of our Legislatures. — He has affected to render the Military independent of and superior to the Civil power. — He has combined with others to subject us to a jurisdiction foreign to our constitution, and unacknowledged by our laws; giving his Assent to their Acts of pretended Legislation: — For quartering large bodies of armed troops among us: — For protecting them, by a mock Trial, from punishment for any Murders which they should commit on the Inhabitants of these States: — For cutting off our Trade with all parts of the world: — For imposing Taxes on us without our Consent: — For depriving us in many cases, of the benefits of Trial by Jury: — For transporting us beyond Seas to be tried for pretended offences. — For abolishing the free System of English Laws in a neighbouring Province, establishing therein an Arbitrary government, and enlarging its Boundaries so as to render it at once an example and fit instrument for introducing the same absolute rule into these Colonies: — For taking away our Charters, abolishing our most valuable Laws, and altering fundamentally the Forms of our Governments. — For suspending our own Legislatures, and declaring themselves invested with power to legislate for us in all cases whatsoever. — He has abdicated Government here, by declaring us out of his Protection and waging War against us. — He has plundered our seas, ravaged our Coasts, burnt our towns, and destroyed the lives of our people. — He is at this time transporting large Armies of foreign Mercenaries to compleat the works of death, desolation and tyranny, already begun with circumstances of Cruelty & perfidy scarcely paralleled in the most barbarous ages, and totally unworthy the Head of a civilized nation. — He has constrained our fellow Citizens taken Captive on the high Seas to bear Arms against their Country, to become the executioners of their friends and Brethren, or to fall themselves by their Hands. — He has excited domestic insurrections amongst us, and has endeavoured to bring on the inhabitants of our frontiers, the merciless Indian Savages, whose known rule of warfare, is an undistinguished destruction of all ages, sexes and conditions. In every stage of these Oppressions We have Petitioned for Redress in the most humble terms. Our repeated Petitions have been answered by repeated injury. A Prince, whose character is thus marked by every act which may define a Tyrant, is unfit to be the ruler of a free people. Nor have We been wanting in attentions to our British brethren. We have warned them from time to time of attempts by their legislature to extend an unwarrantable jurisdiction over us. We have reminded them of the circumstances of our emigration and settlement here. We have appealed to their native justice and magnanimity, and we have conjured them by the ties of our common kindred to disavow these usurpations, which, would inevitably interrupt our connections and correspondence. They too have been deaf to the voice of justice and of consanguinity. We must, therefore, acquiesce in the necessity, which denounces our Separation, and hold them, as we hold the rest of mankind, Enemies in War, in Peace Friends.

We, therefore, the Representatives of the united States of America, in General Congress, Assembled, appealing to the Supreme Judge of the world for the rectitude of our intentions, do, in the Name, and by Authority of the good People of these Colonies, solemnly publish and declare, That these United Colonies are, and of Right ought to be Free and Independent States; that they are Absolved from all Allegiance to the British Crown, and that all political connection between them and the State of Great Britain, is and ought to be totally dissolved; and that as Free and Independent States, they have full Power to levy War, conclude Peace, contract Alliances, establish Commerce, and to do all other Acts and Things which Independent States may of right do. — And for the support of this Declaration, with a firm reliance on the protection of divine Providence, we mutually pledge to each other our lives, our Fortunes and our sacred Honor.

Button Gwinnett
Lyman Hall
Geo Walton

Wm Hooper
Joseph Hewes
John Penn

Edward Rutledge
Thos Heyward Junr.
Thomas Lynch Junr.
Arthur Middleton

John Hancock

Samuel Chase
Wm Paca
Thos Stone
Charles Carroll of Carrollton

George Wythe
Richard Henry Lee
Th Jefferson
Benj Harrison
Thos Nelson jr.
Francis Lightfoot Lee
Carter Braxton

Robt Morris
Benjamin Rush
Benj Franklin
John Morton

Geo Clymer
Jas Smith
Geo Taylor
James Wilson
Geo Ross

Caesar Rodney
Geo Read
Tho M:Kean

Wm Floyd
Phil Livingston
Frans Lewis
Lewis Morris

Richd Stockton
Jno Witherspoon
Fras Hopkinson
John Hart
Abra Clark

Josiah Bartlett
Wm Whipple
Saml Adams
John Adams
Robt Treat Paine
Elbridge Gerry
Step Hopkins
William Ellery
Roger Sherman
Sam Huntington
Wm Williams
Oliver Wolcott
Matthew Thornton

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promptly printed and read to a large crowd in the yard of the State House on July 8. On July 19, the Congress ordered the Declaration to be *engrossed* (written in stylish script) on parchment. It also ordered that all its members sign the engrossed copy. Eventually, 56 members signed.

The importance of the Declaration goes far beyond the reasons it provided for abolishing the colonies' allegiance to King George III. Drawing upon the writings of the English philosopher John Locke and other English thinkers, it states two universal principles that have been important to developing democracies ever since.

The first principle is that governments exist for the benefit of the people and not their rulers. When a government turns to *tyranny* (unjust use of power), the people of that country have a right to resist and overturn the government.

The second principle of the Declaration is that "all men are created equal." This principle has served as a powerful reminder that all members of a society are entitled to the full protection of the law and to the right to participate in public affairs.

The original parchment copy of the Declaration is housed in the National Archives Building in Washington, D.C. It is displayed with two other historic American documents—the United States Constitution and the Bill of Rights. Jack N. Rakove

See also **Continental Congress; Independence Day; Locke, John; Revolutionary War in America; United States, History of the.**

Additional resources

Fradin, Dennis B. *The Declaration of Independence.* Childrens Pr., 1988. Younger readers.

Hawke, David F. *A Transaction of Free Men: The Birth and Course of the Declaration of Independence.* 1964. Reprint. Da Capo, 1989.

Maier, Pauline. *American Scripture: Making the Declaration of Independence.* Knopf, 1997.

Schleifer, Jay. *Our Declaration of Independence.* Millbrook, 1992. Younger readers.

The Declaration of Independence

The Declaration of Independence can be divided into four parts: (1) The Preamble; (2) A Declaration of Rights; (3) A Bill of Indictment; and (4) A Statement of Independence. The text of the Declaration is printed in boldface. It follows the spelling and punctuation of the parchment copy. But unlike the parchment copy, each paragraph begins on a new line and is indented. The paragraphs printed in lightface are not part of the Declaration. They explain the meaning of various passages or give examples of injustices that a passage mentions.

In Congress, July 4, 1776. The unanimous Declaration of the thirteen united States of America,

[The Preamble]

When in the Course of human events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation.—

This paragraph tells why the Continental Congress drew up the Declaration. The members felt that when a people must break their ties with the mother country and become independent, they should explain their reasons to the world.

[A Declaration of Rights]

We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.—

In stating this principle of equality, the signers of the Declaration did not mean to deny all the inequalities of their own time. Americans had already rejected the idea of a legal aristocracy, but many still approved of or tolerated slavery. Most also assumed that the rights and duties of free men differed from those of free women. But over the years, this section has inspired the struggle against unequal treatment of the races and the sexes. The rights to "Life" included the right to defend oneself against physical attack and against unjust government. The right to "Liberty" included the right to criticize the government, to worship freely, and to form a government that protects liberty. The "pursuit of Happiness" meant the right to own property and to have it safeguarded. It also meant the right to strive for the good of all people, not only for one's personal happiness.

That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed,—

The Declaration states that governments exist to protect the rights of the people. Governments receive their power to rule only through agreement of the people.

That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or to abolish it, and to institute new Government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happiness. Prudence, indeed, will dictate that Governments long established should not be changed for light and transient causes; and accordingly all experience hath shewn, that mankind are more disposed to suffer, while evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed. But when a long train of abuses and usurpations, pursuing invariably the same Object evinces a design to reduce them under absolute Despotism, it is their right, it is their duty, to throw off such Government, and to provide new Guards for their future security.—

People may alter their government if it fails in its purpose. Or they may set up a new government. People should not, however, make a revolutionary change in long-established governments for unimportant reasons. But they have the right to overthrow a government that has committed many abuses and seeks complete control over the people.

[A Bill of Indictment]

Such has been the patient sufferance of these Colonies; and such is now the necessity which constrains them to alter their former Systems of Government. The history of the present King of Great Britain is a history of repeated injuries and usurpations, all having in direct object the establishment of an absolute Tyranny over these States. To prove this, let Facts be submitted to a candid world.—

The Declaration states that the colonists could no longer endure the abuses of their government and so must change it. It accuses King George III of inflicting the abuses to gain total power over the colonies. It then lists the charges against him.

The Declaration of Independence (1786), an oil painting on canvas by John Trumbull; Yale University Art Gallery, New Haven, Conn.

The Continental Congress adopted the Declaration of Independence on July 4, 1776. In the painting above, the president of the Congress, John Hancock, sits at the right. Before him stand the five committee members named to draft the Declaration. They are, *left to right,* John Adams, Roger Sherman, Robert R. Livingston, Thomas Jefferson, and Benjamin Franklin.

He has refused his Assent to Laws, the most wholesome and necessary for the public good.—

All laws passed by the colonial legislatures had to be sent to Great Britain for approval. George rejected many of the laws as harmful to Britain or its empire.

He has forbidden his Governors to pass Laws of immediate and pressing importance, unless suspended in their operation till his Assent should be obtained; and when so suspended, he has utterly neglected to attend to them.—

Royal governors could not approve any colonial law that did not have a clause suspending its operation until the king approved the law. Yet it took much time, sometimes years, for laws to be approved or rejected.

He has refused to pass other Laws for the accommodation of large districts of people, unless those people would relinquish the right of Representation in the Legislature, a right inestimable to them and formidable to tyrants only.—

The royal government failed to redraw the boundaries of legislative districts so that people in newly settled areas would be fairly represented in the legislatures.

He has called together legislative bodies at places unusual, uncomfortable, and distant from the depository of their public Records, for the sole purpose of fatiguing them into compliance with his measures.—

Royal governors sometimes had the members of colonial assemblies meet at inconvenient places.

He has dissolved Representative Houses repeatedly, for opposing with manly firmness his invasions on the rights of the people.—

Royal governors often dissolved colonial assemblies for disobeying their orders or for passing resolutions against the law.

He has refused for a long time, after such dissolutions, to cause others to be elected; whereby the Legislative powers, incapable of Annihilation, have returned to the People at large for their exercise; the State remaining in the mean time exposed to all the dangers of invasion from without, and convulsions within.—

After dissolving colonial legislatures, royal governors sometimes took a long time before allowing new assemblies to be elected.

He has endeavoured to prevent the population of these States; for that purpose obstructing the Laws for Naturalization of Foreigners; refusing to pass others to encourage their migrations hither, and raising the conditions of new Appropriations of Lands.—

The colonies wanted immigrants to settle in undeveloped lands in the West. For this reason, their laws made it easy for settlers to buy land and to become citizens. But in 1763, King George claimed the Western lands and began to reject most new *naturalization* (citizenship) laws. In 1773, he prohibited the naturalization of foreigners. In 1774, he sharply raised the purchase prices for the Western lands.

He has obstructed the Administration of Justice, by refusing his Assent to Laws for establishing Judiciary powers.—

The North Carolina legislature passed a law setting up a court system. But Britain objected to a clause in the law, which the legislature refused to remove. As a result, the colony had no courts for several years.

He has made Judges dependent on his Will alone, for the tenure of their offices, and the amount and payment of their salaries.—

The royal government insisted that judges should serve as long as the king was pleased with them and that they should be paid by him. The colonies felt that judges should serve only as long as they proved to be competent and honest. They also wanted to pay the judges' salaries.

He has erected a multitude of New Offices, and sent hither swarms of Officers to harrass our people, and eat out their substance.—

In 1767, Great Britain passed the Townshend Acts, which taxed various products imported into the colonies. Britain also set up new agencies to enforce the laws and appointed tax commissioners. The commissioners, in turn, hired a large number of agents to aid them in collecting the taxes.

He has kept among us, in times of peace, Standing Armies without the Consent of our legislatures.—

British armies arrived in North America to fight the French in the French and Indian War (1754-1763). The colonists resented the fact that Great Britain kept its troops in the colonies after the war.

He has affected to render the Military independent of and superior to the Civil power.—

The British altered the civil government in Massachusetts and named as governor General Thomas Gage, commander of Britain's military forces in America.

He has combined with others to subject us to a jurisdiction foreign to our constitution, and unacknowledged by our laws; giving his Assent to their Acts of pretended Legislation:—

The Declaratory Act, passed by Britain in 1766, claimed that the king and Parliament had full authority to make laws for the colonies. However, the Declaration of Independence maintained that the colonies' own laws did not give the British that authority.

For quartering large bodies of armed troops among us:—

The royal government passed various quartering acts, which required the colonies to provide lodging and certain supplies to British troops stationed in America.

For protecting them, by a mock Trial, from punishment for any Murders which they should commit on the Inhabitants of these States:—

In 1774, Britain passed the Impartial Administration of Justice Act. Under this act, British soldiers and officials accused of murder while serving in Massachusetts could be tried in Britain.

For cutting off our Trade with all parts of the world:—

Britain passed many laws to control colonial trade. The Restraining Acts of 1775, for example, severely limited the foreign trade that several colonies could engage in. One act provided that American ships that violated the law could be seized.

For imposing Taxes on us without our Consent:—

This charge referred to all taxes levied on the colonies by the British, beginning with the Sugar Act of 1764.

For depriving us in many cases, of the benefits of Trial by Jury:—

British naval courts, which had no juries, dealt with smuggling and other violations of the trade laws.

For transporting us beyond Seas to be tried for pretended offences:—

This charge referred to a 1769 resolution by Parliament that colonists accused of treason could be sent to Britain for trial.

For abolishing the free System of English Laws in a neighbouring Province, establishing therein an Arbitrary government, and enlarging its Boundaries so as to render it at once an example and fit instrument for introducing the same absolute rule into these Colonies:—

In 1774, the Quebec Act provided for French civil law and an appointed governor and council in the province of Quebec. The act also extended Quebec's borders south to the Ohio River.

For taking away our Charters, abolishing our most valuable laws, and altering fundamentally the Forms of our Governments:—

The Massachusetts Government Act of 1774 drastically changed the Massachusetts charter. It provided that councilors would no longer be elected but would be appointed by the king. The act also restricted the holding of town meetings and gave the governor control over all lower court judges.

For suspending our own Legislatures, and declaring them-

Pulling Down the Statue of George III, an engraving (1859) by John C. McCrae based on a painting by Johannes A. S. Oertel; Library of Congress

Celebrating the Declaration of Independence, the Sons of Liberty of New York City toppled a statue of King George III of Great Britain, *left.* The celebration occurred in New York City on July 9, 1776, after a public reading of the Declaration. The Sons of Liberty later melted the lead statue to make bullets for American patriots to use against the British in the Revolutionary War.

WORLD BOOK photo by Pete Souza

The original Declaration of Independence is displayed in an upright case in the National Archives Building in Washington, D.C. The document is sealed under glass.

selves invested with power to legislate for us in all cases whatsoever.—

In 1767, Parliament passed an act suspending the New York Assembly for failing to fulfill all the requirements of the Quartering Act of 1765.

He has abdicated Government here, by declaring us out of his Protection and waging War against us.—

Early in 1775, Britain authorized General Gage to use force if necessary to make the colonists obey the laws of Parliament. The British fought the colonists at the battles of Lexington, Concord, and Bunker Hill. George declared the colonies to be in revolt and stated they would be crushed.

He has plundered our seas, ravaged our Coasts, burnt our towns, and destroyed the lives of our people.—

The British seized ships that violated the Restraining Act of December 1775. They also bombarded such seaport towns as Falmouth (now Portland), Me.; Bristol, R.I.; and Norfolk, Va.

He is at this time transporting large Armies of foreign Mercenaries to compleat the works of death, desolation and tyranny, already begun with circumstances of Cruelty & perfidy scarcely paralleled in the most barbarous ages, and totally unworthy the Head of a civilized nation.—

The British used German *mercenaries* (hired soldiers) to help fight the colonists.

He has constrained our fellow Citizens taken Captive on the high Seas to bear Arms against their Country, to become the executioners of their friends and Brethren, or to fall themselves by their Hands.—

The British forced American seamen on ships seized under the Restraining Act to join the British navy.

He has excited domestic insurrections amongst us, and has endeavoured to bring on the inhabitants of our frontiers, the merciless Indian Savages, whose known rule of warfare, is an undistinguished destruction of all ages, sexes and conditions.

On Nov. 7, 1775, Virginia's royal governor proclaimed freedom for all black slaves who would join the British forces. British military plans included using Indians to fight colonists in frontier areas.

[A Statement of Independence]

In every stage of these Oppressions We have Petitioned for Redress in the most humble terms: Our repeated Petitions have been answered only by repeated injury. A Prince, whose character is thus marked by every act which may define a Tyrant, is unfit to be the ruler of a free people.

The Continental Congress had asked the king to correct many abuses stated in the Declaration. These appeals were ignored or followed by even worse abuses.

Nor have We been wanting in attentions to our Brittish brethren. We have warned them from time to time of attempts by their legislature to extend an unwarrantable jurisdiction over us. We have reminded them of the circumstances of our emigration and settlement here. We have appealed to their native justice and magnanimity, and we have conjured them by the ties of our common kindred to disavow these usurpations, which, would inevitably interrupt our connections and correspondence. They too have been deaf to the voice of justice and of consanguinity. We must, therefore, acquiesce in the necessity, which denounces our Separation, and hold them, as we hold the rest of mankind, Enemies in War, in Peace Friends.—

Congress had also appealed without success to the British people themselves.

We, therefore, the Representatives of the united States of America, in General Congress, Assembled, appealing to the Supreme Judge of the world for the rectitude of our intentions, do, in the Name, and by Authority of the good People of these Colonies, solemnly publish and declare, That these United Colonies are, and of Right ought to be Free and Independent States; that they are Absolved from all Allegiance to the British Crown, and that all political connection between them and the State of Great Britain, is and ought to be totally dissolved; and that as Free and Independent States, they have full Power to levy War, conclude Peace, contract Alliances, establish Commerce, and to do all other Acts and Things which Independent States may of right do.—

And for the support of this Declaration, with a firm reliance on the protection of divine Providence, we mutually pledge to each other our Lives, our Fortunes and our sacred Honor.

Because all appeals had failed, the signers of the Declaration, as representatives of the American people, felt only one course of action remained. They thus declared the colonies independent, with all ties to Britain ended.

Declaration of Rights. See Bill of rights; Continental Congress; Human Rights, Universal Declaration of; Rights of Man, Declaration of the.

Declaratory Act. See Revolutionary War in America (The quartering and stamp acts).

Declension is a listing of the different case forms of a noun or pronoun. Some languages, such as Latin, Greek, and Russian, have complicated case systems. They have

many different forms for each noun or pronoun, varying with the way the words are used in sentences.

In English, the declension of nouns is extremely simple. English nouns have only two case forms: a *common* case, which is used for both subject and object, and a *possessive* case. For example, in "The coach instructed the team," *coach* is the subject and *team* is the object, but the common case is used for both. The possessive form is often marked by the inflection *-'s,* as in the sentence, "The *coach's* instructions contributed to the *team's* victory."

The declension of pronouns is more complicated. Some pronouns have as many as four forms *(I, me, my, mine).* The subjective and objective cases are distinct *(I, me).* The possessive case distinguishes between an attributive, adjectival form (*my:* This is *my* desk) and a nominal, suppletive form *(mine:* This desk is *mine).* The following declension shows the differences among the forms of the personal pronouns. No apostrophes are used in possessive forms of pronouns.

Subjective	I	we	you	he	she	it	they
Objective	me	us	you	him	her	it	them
Possessive							
Attributive	my	our	your	his	her	its	their
Nominal	mine	ours	yours	his	hers	its	theirs

Sara Garnes

See also **Case; Pronoun.**

Decoding. See **Codes and ciphers.**

Decomposition, in chemistry, is the breaking down of a substance into simpler products, or into the elements of which it is composed. Decomposition may be brought about in several ways. Heat decomposes red mercuric oxide into its elements of oxygen and bright metallic mercury. Heat breaks down limestone to form lime and carbon dioxide. Heat also decomposes many organic compounds. For example, table sugar breaks down mostly into carbon and water when heated. An electric current decomposes water into its elements hydrogen and oxygen. Many substances are decomposed by chemical action. Starch is broken down into a simple sugar, called *glucose,* by the action of a boiling, dilute acid. Decomposition may also be caused by the action of light, bacteria, or enzymes. The enzymes in yeast ferment sugar into simple products.

A distinction is sometimes made between decomposition caused by people, as in chemistry, and decomposition that occurs in nature. For example, animal and vegetable matter, when attacked by certain microorganisms, are said to *decompose,* or decay. Such natural decay is also called *putrefaction.* The decomposition of animals and plants is important in geology. For example, coal and petroleum are formed from plants that became buried in swamps and decayed. Albert G. Anderson

See also **Decay.**

Decompression sickness. See **Bends.**

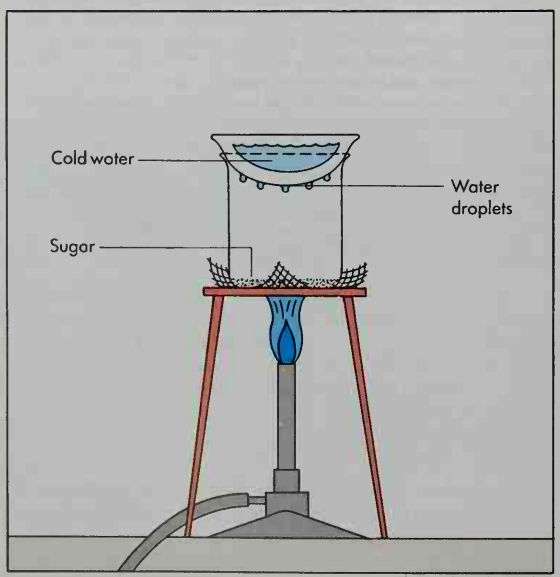
Decoration Day. See **Memorial Day.**

Decorations, medals, and orders. See **Medals, decorations, and orders.**

Decorative arts is a term used to designate a variety of categories including furniture, woodwork, and glass. The term decorative arts also refers to ceramics (porcelain and earthenware) and metalwork (gold, silver, bronze, and other metals).

The decorative arts are called the *applied arts* when referring to objects intended for actual use such as chairs, silver flatware, porcelain dishes, and glass vessels. *Minor arts* is another term occasionally used for decorative arts. This term does not mean that the decorative arts are inferior to other forms. It is intended to separate decorative arts from the *fine arts* of painting, sculpture, and architecture.

The decorative arts reflect the desire throughout human history to decorate the environment. For example, prehistoric peoples created small ivory sculptures. The Egyptians buried finely crafted furniture and jewelry with their dead. During medieval times, artisans deco-



WORLD BOOK diagram by Arthur Grebetz

In decomposition, a substance is broken down into simpler products. Table sugar decomposes into carbon and water when heated. The carbon stays in the beaker. The water forms droplets at the bottom of an evaporating dish filled with cold water.

Spring Flowers Egg, an enamel and gold shell enclosing a basket of wood anemones made of gold, diamonds, garnets, and chalcedony; the *Forbes* Magazine Collection, New York City

A masterpiece of the decorative arts, this Easter egg was crafted by the Russian jeweler Peter Carl Fabergé in 1890.

rated castles and churches with articles made from ivory, gold, and enamel. Artists of the Renaissance produced fine furniture, metalwork, and glass. People of the 1700's created beautiful porcelain pieces and carved woodwork. Today, the decorative arts continue to be an important division of art. Fine art and decorative art reflect important artistic trends in their form, color, and material. John W. Keefe

Related articles in *World Book* include:

Antique
Art and the arts
Beadwork
Colonial life in America (Decorative arts)
Decoupage
Enamel
Fine arts
Furniture
Inlay
Interior design
Ironwork, Decorative
Ivory
Jewelry
Lace
Mosaic
Pottery
Stained glass
Tapestry

Decoupage, *DAY koo PAHZH,* is the art of using paper cutouts to decorate furniture and such accessories as boxes, lamps, plaques, and trays. The finished object that has been decorated looks and feels like fine enamel. Cutouts can be taken from such articles as calendars, greeting cards, magazine and newspaper illustrations, photographs, and wrapping paper. The word *decoupage* comes from the French word *decouper,* meaning *to cut out.*

WORLD BOOK photo

Decoupage is the art of decorating furniture with paper cutouts. The cutout is glued to a surface and covered with many coats of varnish or acrylic. The final coat is waxed and polished.

Four steps are usually involved in the art of decoupage. First, the surface of the object that is to be decorated must be sanded and, if wood, painted or stained. A protective sealer is then applied to the paper cutout, which is then glued to the object. Next, the decorated surface is covered with many coats of varnish or acrylic until the edge of the cutout cannot be felt. Last, the final coat is sanded smooth, polished, and waxed.

Dona Z. Meilach

Deductive method is the process of reasoning by which we draw conclusions by logical inference from given premises. If we begin by accepting the propositions that "All Greeks have beards" and that "Zeno is a Greek," we may validly conclude that "Zeno has a beard." We refer to the conclusions of deductive reasoning as *valid,* rather than *true,* because we must distinguish clearly between that which follows logically from other statements and that which is the case.

Starting premises may be articles of faith, assumptions, or conclusions based on earlier reasoning. To draw valid conclusions, the deductive method uses a special set of rules. These rules are based on the structures of premises and conclusions. Mathematics and logic make extensive use of the deductive method. The scientific method requires a combination of induction and deduction (see **Inductive method**).

Morton L. Schagrin

See also **Logic; Science** (Mathematics and logic).

Deed is a written document to transfer ownership of real estate. The deed must be signed by the *grantor,* the party transferring ownership. In many cases, it is also signed by the *grantee,* the party receiving ownership. The deed must describe the property transferred and show the intent to transfer ownership. The deed takes effect only when it is delivered to the grantee or to the grantee's agent.

There are two main types of deeds—*warranty deeds* and *quitclaim deeds.* A warranty deed guarantees the grantee that the grantor owns all the rights described in the deed. If it turns out that the grantor does not own the rights, the grantor must pay the grantee's resulting damages. A quitclaim deed contains no such guarantee and therefore is used less often.

Unlike the title to an automobile, a deed does not have to be submitted to the government to become valid. However, deeds may be recorded in the office of the recorder of deeds for the county or district in which the land is located. Recording the deed gives public notice of the rights the grantee is receiving. It thus helps protect the grantee against later claims by others to rights in the property.

Many land buyers obtain title insurance to protect themselves against later claims. Before the insurance company insures the buyer, it researches the title to the property and reports its findings to the buyer. Some land buyers hire a lawyer or other specialist to research the title and prepare a brief history of the land's ownership. The history is called an *abstract of title.*

James L. Winokur

Deep refers to any ocean area that has a depth of more than 18,000 feet (5,490 meters). More than 100 deeps have been discovered in ocean floors. Contrary to popular belief, they are not found in the center of the ocean. Most of them are found close to mountainous islands where steep shores plunge down to the bottom of the sea.

The deepest known deep is the Challenger Deep, in the Mariana Trench 200 miles (320 kilometers) southwest of Guam. There, the ocean floor is 35,840 feet (10,924 meters) below the surface. The Puerto Rico Trench, north of Puerto Rico, has the greatest recorded depth in the Atlantic Ocean. It is about 28,232 feet (8,605 meters) below the ocean's surface. Mark A. Cane

See also **Atlantic Ocean** (The ocean depths); **Deep sea; Ocean** (The world ocean; The land at the bottom of the sea); **Pacific Ocean** (The ocean floor).

WORLD BOOK illustration by Tony Gibbons, Bernard Thornton Artists

The deep sea holds some of the most fascinating creatures on the earth. Deep-sea dwellers include the *cirrate octopod* (an octopus), the tripod fish, and many animals that look like plants. The illustration above shows only a few of the creatures from this vast environment. In fact, many of the above animals come from different parts of the deep sea and would not be found living together.

Deep sea is the largest yet least-known habitat on earth. It covers about two thirds of the earth's surface and includes all waters more than 3,300 feet (1,000 meters) below sea level. For centuries, most people assumed that the cold, black depths of the ocean supported little or no life. In the 1900's, however, new types of undersea vessels and other technological developments enabled people to explore this vast frontier. Scientists have discovered a great variety of living things in the deep sea. Some deepwater creatures are among the most bizarre on earth.

The deep-sea environment

Environmental conditions in the deep ocean are like conditions nowhere else on earth. The water is bitterly cold. Temperatures hover just above freezing, from 34 to 39 °F (1 to 4 °C). The pressure in the deep sea can be up to 1,000 times as great as the pressure on the surface. In the ocean depths, the weight of the waters above exerts enough pressure to crush the unprotected body of any surface life form. No sunlight penetrates to the deep sea, so its creatures live in almost total darkness.

Food is scarce in the deep sea. All living things are part of a *food chain*, the system by which energy is transferred from one living thing to another in the form of food. On land and in shallow waters, every food chain begins with the energy from sunlight. Plants use this energy to make food in a process called *photosynthesis*, and other living things rely on plants. In the ocean depths, there are no plants because there is no light to

support photosynthesis. The key to life for most deep-sea creatures is *marine snow,* a constant fall of plant and animal fragments from the waters above.

Parts of the deep sea contain more animals than can possibly be supported by marine snow. In these areas, specialized organisms manufacture nutrients from sulfides and other chemicals in a process called *chemosynthesis.*

The deep-sea floor

The ocean floor is a landscape of low mountains, broad plains, and deep trenches. Underwater mountains called *mid-ocean ridges* cover about 80 percent of the Pacific Ocean floor and about 50 percent of the Atlantic Ocean floor. Most peaks of the mid-ocean ridges rise less than 5,000 feet (1,500 meters) above the sea floor. Scientists believe many of them are extinct volcanoes.

Explorers discovered the mountain chains independently in the Atlantic, Indian, and Pacific oceans and gave them different names, including the Mid-Atlantic Ridge in the Atlantic Ocean, the Mid-Indian Ridge in the Indian Ocean, and the East Pacific Rise in the Pacific Ocean. Today, scientists realize that the ridges form a single mountain chain that runs about 37,000 miles (60,000 kilometers) through the three oceans.

The sides of mid-ocean ridges slope down into flat stretches of ocean floor called *abyssal plains.* Accumulated *sediment* (deposits of sand and mud) makes the abyssal plains some of the flattest areas on earth.

Trenches are the deepest parts of the ocean. Many trenches occur in the Pacific Ocean, especially in its western portion. Most trenches are long, narrow, and deep, 2 to 2.5 miles (3 to 4 kilometers) below the surrounding sea floor. The greatest depth anywhere in the ocean is found in the Mariana Trench southeast of Japan. It plunges more than 6.8 miles (11 kilometers) below sea level. Frequent earthquakes and volcanic eruptions occur along the trenches. Many trenches lie near chains of volcanic islands called *island arcs.*

Among the most fascinating parts of the deep sea are underwater hot springs called *hydrothermal vents.* Hydrothermal vents contain thousands of times more living matter than animal communities elsewhere in the deep sea. Such microscopic organisms as bacteria and *archaea* thrive on sulfides that shoot out of the vents. These organisms, in turn, support other teeming life. The best-known vents occur near mid-ocean ridges.

Diverse communities of life also exist near underwater cold springs called *cold seeps,* where the water welling up from within the earth is cold instead of hot. Sulfides in these waters support the same kinds of life forms found near hydrothermal vents.

Hydrothermal vents and cold seeps are short-lived, lasting from a few years to perhaps 100 years. When they no longer discharge sulfides, nearby animals die.

Life in the deep sea

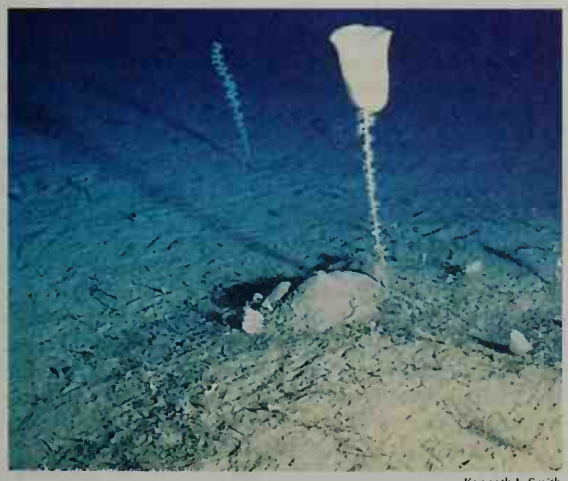
Deep-sea life is unfamiliar, even to most biologists. Oceanographers believe that as many kinds of animals live in the deep sea as live in tropical rain forests and coral reefs. In fact, there may be 10 million or more deepwater animal species. Many creatures have beautiful but bizarre bodies shaped by the extreme cold, lack of light, and tons of pressure in the ocean depths.

Deep-sea life can be divided into three groups: (1) microscopic creatures called *microorganisms,* (2) *invertebrates* (animals without backbones), and (3) fish.

Microorganisms make up the largest group of living things in the deep sea. Common deepwater microorganisms include single-celled bacteria and archaea, which provide food for many other creatures. Bacteria are so numerous in some places that they form colonies of huge, ruglike mats.

Invertebrates are the most common animals in the deep sea. Numerous worms, crabs, and other small invertebrates live beneath the sediment on the sea floor. Many other invertebrates live near the floor.

Sponges represent a diverse group of deep-sea invertebrates. Some deepwater sponges grow quite large. The giant *barrel sponge,* for example, may reach 6 feet (1.8 meters) in height. The weak, slow deepwater currents enable sponges to have delicate bodies. *Glass*



Kenneth L. Smith

A glass sponge rises from the ocean floor like a delicate flower. This variety of sponge has a skeleton consisting of fine threads of glasslike material called *silica.*

NSF Oasis Program

Tubeworms have red gill-like organs that they retract when disturbed. Tubeworms are among the most prominent animals that live around *hydrothermal vents* (underwater hot springs).

A deep-sea viperfish has large jaws and teeth. Its jellylike skin acts as a cushion to protect it from deep-sea pressure, which can be hundreds of times greater than the pressure on the surface.

© Norbert Wu

sponges, for example, have skeletons that consist of fine hairs of *silica,* a glasslike mineral. Their cup-shaped bodies sit on a stalklike structure that attaches them to the ocean floor. Many sponges of the deep sea are white or gray rather than the yellow or orange of their shallow-water relatives. Shallow-water sponges have pigments to protect them from harmful sunrays. However, deep-sea sponges do not need such protection because no sunlight reaches their environment.

Many invertebrates share the ocean bottom with sponges. Sea anemones, starfish, and other animals fasten themselves to glass sponges' stalks. Scattered among the deep-sea sponges are various plantlike animals, including *stalked sea lilies* and *featherstars.* Many of these deep-sea animals look like flowers or giant, hairy spiders.

Such animals as crabs, starfish, and worms grow larger in the deep sea than in the shallows. For example, one deep-sea starfish grows larger than a basketball.

The black deep-sea waters hide and protect many creatures with brightly colored bodies. One such animal is a deepwater *ostracod,* a relative of crabs and shrimp. It has a bold orange-red body about the size and shape of a cherry. This color would make the animal vulnerable to predators in shallow waters. But in the dark deep sea, the ostracod can avoid enemies by blending almost completely into the blackness.

Deep-sea shrimp, like many other deepwater animals, are *bioluminescent*—that is, they emit heatless light from their bodies. A chemical reaction in the shrimp's light organs produces greenish-yellow flashing lights, which act as a signal to attract mates.

Among the most common deep-sea invertebrates are *sea cucumbers.* These animals have been found in the deepest parts of the ocean. Many sea cucumbers live atop the mud, wriggling like fat worms. A few deep-sea species, however, swim gracefully through the dark water.

Many invertebrates live in waters just above the ocean bottom. Among the most unusual of these animals is a species of *siphonophore.* This jellylike colony of creatures is shaped like a string of glowing pearls and lined with stinging cells. The colony may reach a length of 60 feet (18 meters).

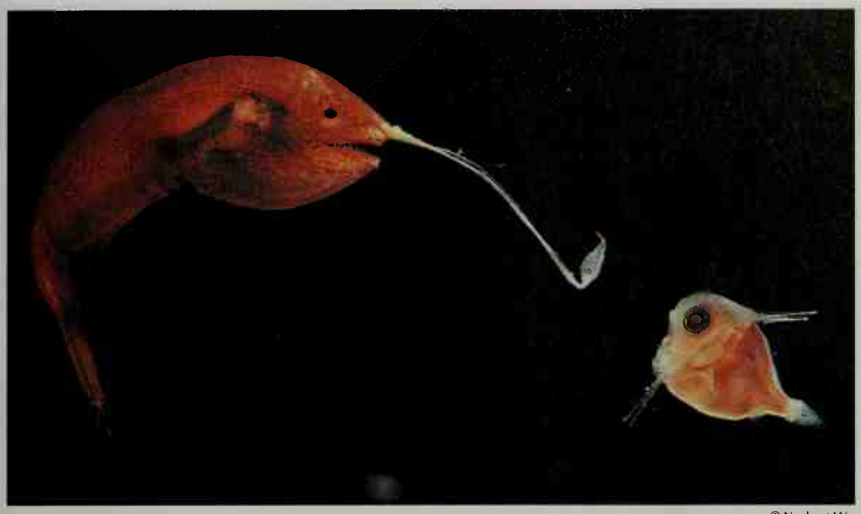
One of the most graceful animals of the deep sea also lives just above the ocean floor. The *cirrate octopod,* a deep-sea octopus, is so jellylike that it was originally mistaken for a jellyfish. Cirrate octopods are named for the fingerlike projections called *cirri* that line their webbed arms. These cirri sense food in a dark world. The animal's jellylike skin helps it withstand deep-sea pressure. The skin consists of about 95 percent water, which is almost impossible to compress and thus cushions the animal's body.

Different kinds of squids also live in the deep sea. The fearsome giant squid is one of the most famous kinds, but it is also among the least known. Though the animal may grow 60 feet (18 meters) long, no scientist has ever seen a living giant squid. People know about these creatures only from dead individuals that have washed onto beaches after storms.

A great variety of invertebrates live around hydrothermal vents. Giant white *tubeworms* are among the best-known of these animals. They grow up to 10 feet (3 meters) long and have red gill-like organs that they retract when disturbed. Tubeworms have no digestive tract. Instead, they get their food from bacteria that live within their organs. In return, they provide the bacteria with a place to live. Tubeworms also extract sulfides from the water, which the bacteria need for food. This biological relationship is an example of *symbiosis,* in which two creatures live together to their mutual benefit.

Near the tubeworms live dinner-plate-sized clams and mussels, as well as the huge mats of bacteria upon which these animals depend. A species of *siphonophore* is often found floating above the bacteria. This unusual organism resembles a dandelion flower. Many of the invertebrates that live around hydrothermal vents have not yet been classified or even discovered.

Fish are the only *vertebrates* (backboned animals) that inhabit the deep ocean. Deep-sea fish are very different from those found in shallow waters. Most deepwater fish are extremely small, growing only a few inches or centimeters in length. Like many invertebrates, deep-



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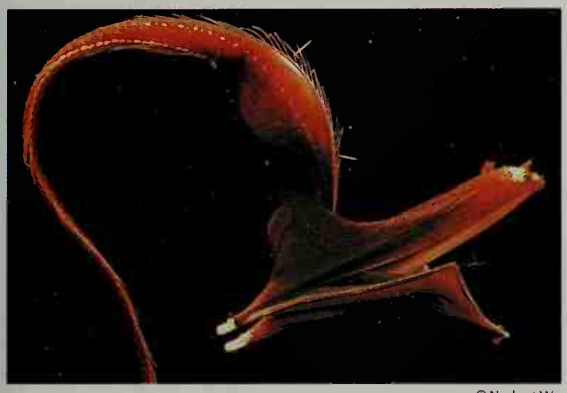
A deep-sea anglerfish, *left,* lures prey with a special light-producing organ at the end of a long, flexible spine that looks like a fishing pole.



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The gulper eel has a delicate body with a huge mouth. It can open its mouth wide enough to swallow a fish much larger than itself. The gulper's tiny eyes sit on the front tip of its head.

water fish often have jellylike skin to withstand pressure in the ocean depths. Deep-sea fishes are usually weak swimmers. Most drift slowly through the weak deep-sea currents, expending as little energy as possible. The eyes of deep-sea fishes are almost always very small, and some fish are totally blind.

One deep-sea fish, called the *rattail* or *grenadier,* is thought to be the most widespread animal in the world. This fish has been found in deep waters from the equator to the polar seas.

Like deep-sea shrimp, numerous deepwater fishes are bioluminescent. The *anglerfish* has a light-producing organ above its mouth to lure prey. The organ is located on a long, flexible spine that looks like a fishing pole.

Anglerfish and another deep-sea predator, the *Viperfish,* have mouths full of long, sharp teeth to capture prey. Like many other deepwater creatures, these fish have rates of digestion many times slower than those of upper-ocean animals. Food is so scarce in the ocean depths that deep-sea animals must use nourishment slowly to survive.

One of the most unusual-looking fish is the *gulper eel.* Its body is almost all mouth. The gulper eel can stretch its mouth wide enough to gulp down a fish much larger than itself.

Another strange deep-sea creature, the *tripod fish,* rests on the bottom of the ocean on three elongated fins. This posture gives it the appearance of a tripod or three-legged stool.

Deep-sea exploration

Undersea explorers and scientists are only beginning to understand the deep sea. Until the mid-1800's, most scientists believed there was little or no life at the bottom of the ocean. Then in the 1870's, people began to find deep-sea creatures by using dredges. They lowered these scoops under the ocean surface and brought up samples from the sea floor.

In the 1930's, scientists began to develop diving vehicles that enabled them to explore the ocean at greater and greater depths. In 1967, marine biologists first used the *epibenthic sled,* an underwater collecting device resembling a scoop. Deep-sea samples collected by this machine contained many more animals than samples gathered in shallower waters. These findings gave scientists a much more accurate idea of the vast array of life on the ocean floor.

In the late 1970's, scientists began to get firsthand looks at sea-floor life through the windows of underwater vessels called *submersibles.* Scientists also explored deep waters with remotely operated vehicles and robots lowered from research ships. Despite this progress, researchers estimate that less than 1 percent of the deep sea had been explored by the end of the 1900's.

Cheryl Lyn Dybas

Related articles in *World Book* include:

Ballard, Robert Duane
Deep
Diving, Underwater
Earle, Sylvia Alice
Exploration (Deep-sea exploration)
Fish (Fish of the deep ocean; pictures)
Marine biology
Ocean
Ocean Drilling Program
Ooze

Deep-sea diving. See Diving, Underwater.
Deep Sea Drilling Project. See Atlantic Ocean (Exploration); Ocean Drilling Program.

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Male and female white-tailed deer differ in appearance chiefly in that the males have antlers. The male deer above has new antlers with a furry covering called *velvet,* which he will soon rub off.

Deer are the only animals with bones called *antlers* on their heads. Antlers differ from horns, which are strong, hard layers of skin with a bony core. Deer rank among the most common large wild animals throughout much of the world.

The deer family includes more than 30 different species, such as the common North American mule deer and white-tailed deer. Other members of the deer family include the elk, caribou, reindeer, and moose. Some deer live in hot, dry deserts. Others live in cold regions above the Arctic Circle. However, most kinds of deer live in prairies, swamps, or woodlands that have a mild climate.

In most species of deer, only the males have antlers. Most male deer are called *bucks,* but in some species the males are known as *stags* or *harts.* Female deer are called *does* or *hinds,* and young deer are called *fawns.*

Since early times, people have used deerskins for clothing and deer meat, known as *venison,* for food. After European settlers came to North America, they killed so many deer that many species became extinct in some regions. In many areas, deer populations recovered after the animals were reintroduced from other regions and protected by hunting laws.

Today, 20 to 25 million deer roam the United States and Canada. Deer have become nuisances in many areas, especially suburban communities. The animals destroy shrubs and plantings and transport ticks that carry Lyme disease. People who are bitten by infected ticks can develop arthritis, heart abnormalities, and disorders of the nervous system. Deer also cause hundreds of thousands of traffic accidents each year.

Wildlife management experts believe hunting is the most practical method for controlling deer overpopulation. In many states, game managers have expanded deer hunting by granting more licenses to hunters and extending hunting seasons.

Kenneth J. Raedeke, the contributor of this article, is Associate Professor of Forest Resources at the University of Washington.

The body of a deer

Deer are *mammals*—that is, animals whose young feed on milk produced by the mother. Like other mammals, deer are *warm-blooded,* which means their body temperature remains fairly constant regardless of the surrounding temperature. Deer have a covering of hair

on their body that helps keep them warm in cold weather. The hairs are hollow, with air in the middle of each strand that serves as insulation. Deer in tropical regions have a much thinner coat.

Legs and hoofs. All deer have long, thin legs, which make them good runners. They move their legs rapidly and take long steps. A deer's foot is really two center toes. Each of the toes is protected by a hard covering called a *hoof.* A deer runs on tiptoe with a springing or bouncing motion. Two other toes, called *dewclaws,* grow higher on the leg and have no use when the animal runs. The dewclaws often leave dots at the back of a deer's track in snow. Deer use their speed to avoid predators. A frightened white-tailed deer can run as fast as 40 miles (64 kilometers) per hour and can leap 15 to 20 feet (4.6 to 6.1 meters) forward.

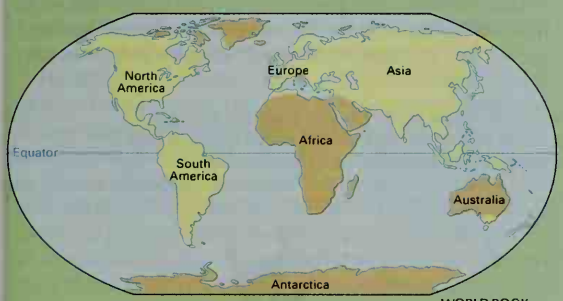
Head. Deer have narrower heads and somewhat smaller noses and mouths than cattle do. The deer's lips move easily, and the animal uses them to grasp food. Most kinds of deer have only bottom teeth in the front of the mouth. A thick pad of rough skin takes the place of upper front teeth. The lower teeth press against this pad when the deer tears off leaves and twigs to eat. The upper and lower back teeth have many sharp-pointed tips. The deer uses these back teeth to chew its food.

A deer has large eyes at the sides of its head. However, the animal depends on its ears and its nose to catch the first warnings of danger. A deer has keen hearing and smell. Its ears are always erect, and they move to catch sounds from any direction. The animal can identify the direction from which a sound is coming. A deer usually faces into the wind when it eats or rests. The wind carries sounds and smells of approaching predators or other dangers.

Antlers are part of a deer's skull. In most deer species, only males grow antlers. However, female reindeer have antlers as well. The antlers' hard, bony structure and sharp points make them extremely dangerous weapons. Male deer use them chiefly to fight for mates or for leadership of a herd. Deer that live in mild or cold climates shed their antlers each winter and begin to grow a new set in late spring. Deer in warmer climates may lose their antlers and grow new ones at other times of the year.

New antlers are soft and tender and grow rapidly. A thin layer of skin covers the antlers and contains blood vessels that stimulate growth. The skin layer is called *velvet* because it has short, fine hairs that give it the soft

Where deer live



WORLD BOOK map

Deer live on every continent except Antarctica and rank among the most widespread large mammals in the world. They have been introduced into places, such as Australia, where they did not live naturally. The yellow areas of the map show the parts of the world in which deer live.

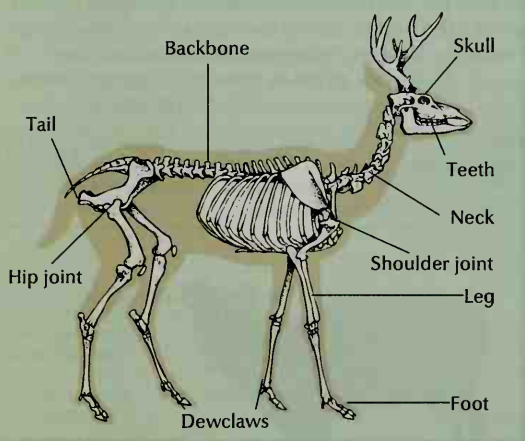
How a deer's antlers grow

Many deer lose their antlers each winter and begin to grow new ones in late spring. The new antlers are soft and tender. A thin, furry skin called *velvet* covers the growing antlers. Full-grown antlers are hard and strong, and have no velvet.

WORLD BOOK illustration by Tom Dolan

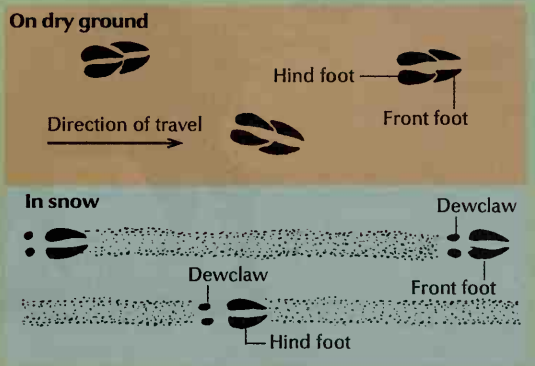
The skeleton of a deer

WORLD BOOK illustration by John D. Dawson



The tracks of a deer

WORLD BOOK illustration by Tom Dolan



appearance of velvet. As the antlers reach full size, the velvet dries and the deer scrapes it off on the ground or against trees or bushes.

All antlers have branches that end in *tines* (points or prongs). But the shape of the antlers varies among species of deer. For example, white-tailed deer typically have unbranched tines that arise from a main beam, while mule deer have branched tines. Sometimes deer grow unusual antlers that may have many tines arranged in unique shapes.

The size and shape of a deer's antlers depend on the animal's size, age, and health. A deer first grows antlers when it is 1 or 2 years old. In most deer, these first antlers are short and somewhat straight. Each year, the antlers grow longer and larger, and more branches form. However, after a deer reaches maturity, the number of tines on its antlers may decline.

When deer are in poor condition, they grow smaller antlers or antlers with fewer tines. In areas where there are too many deer and not enough food for all the animals, some young male deer may have only one tine or may not even grow antlers.

Life of a deer

Deer have no permanent homes, dens, or bedding sites. They roam an area called a *home range* in search of food and mates. They may live in groups or alone, depending on their age, sex, and species. Males generally stay with the females only during the breeding season and do not assist in raising the fawns. The home range of males is often much larger than that of females.

Many deer move to more favorable locations when the seasons change. For instance, mountain deer move to lower lands for the winter. They spend the summer in high alpine meadows and forests, feeding on grasses, flowers, and shrubs. In late fall, they travel to the warmer lower areas. In early spring, they return to the mountains to give birth and start the cycle again.

Deer usually stay near the edges of forests, patches of shrubs, or swampy areas. The trees, shrubs, and grasses supply food. They also serve as a place to sleep, to hide from predators, or to give birth. In areas of farmland, deer may stay close to small woodlots or hide in tall grass or shrubs along creeks or fence lines.

Young. A female deer carries her young inside her body for about six to nine months, depending on the species. She chooses a hidden spot away from other deer to give birth. Young deer usually remain hidden until they can walk well enough to follow their mother. Most kinds of deer have one young at a time. However, white-tailed deer and mule deer usually have twins. The Chinese water deer, which live along the Yangtze River in China, give birth to the most young at once. These deer can have four to seven fawns at a time.

Food. Deer feed on a wide variety of plants. In spring, when food is plentiful, deer eat mostly grasses, flowers, buds, and young leaves. During the summer, when grasses and leaves dry up, they eat twigs, stems, and mature leaves. In winter, deer feed on twigs and small tree branches. When food becomes extremely scarce, deer will eat bark.

Deer do not chew their food well before swallowing it. A deer's stomach has four chambers. One chamber serves as a storage place, which enables the animal to

Deer of the world

Deer rank among the most widespread large mammals on the earth. The red deer, for example, lives in Africa, Asia, Europe, and North America. North American red deer are called American elk. The mule deer also inhabits North America, and the pudu makes its home in South America.

WORLD BOOK illustrations by Paul Turnbaugh

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A herd of chital deer drink at a water hole. These beautiful animals have sleek spotted coats and tall, elegant antlers. They live in the grasslands and open forests of India and Sri Lanka.

eat large amounts of food quickly. Deer do not need to spend long periods at feeding grounds where predators might see them. Later, when a deer has found a safe place, the stored food returns to the mouth in a ball-like glob. The deer chews this food, called *cud,* and it goes to other parts of the stomach. Animals that digest this way are called *ruminants* (see **Ruminant**).

Habits. Deer use their keen senses, their knowledge of their home range, and their speed to avoid enemies. A deer can outrun most predators, including bears, cougars, wolves, and human beings. But a deer's primary means of escaping danger is to avoid detection. Unless startled, most deer will stand motionless and let a predator pass. White-tailed deer and mule deer prefer to feed at dawn and dusk at the edges of forests, where they blend in best with their surroundings.

© Kenneth W. Fink, Photo Researchers

A brocket deer has antlers that resemble spikes. Brocket deer are small, growing only about 2.5 feet (75 centimeters) tall at the shoulders. This red brocket deer lives in the forests of Mexico.

Wild deer can live to be 10 to 20 years old. In captivity, some deer live longer than this. However, the roe deer of Europe lives 10 to 12 years in the wild but only 3 to 7 years in a zoo.

Kinds of deer

Many kinds of deer live in North America, Central and South America, Asia, and Europe. Deer also have been introduced into places where they did not live naturally, including Australia, Hawaii, and New Zealand.

North American deer. The North American deer include white-tailed deer and mule deer. Buckskin was originally made from the hides of these species of deer.

White-tailed deer, also called *Virginia deer,* are the most common large game animal of North America. They are found in nondesert areas from northern Canada to Peru in South America. A male white-tailed deer may stand 3.5 feet (1.1 meters) tall at the shoulders and weigh 200 pounds (91 kilograms). This deer has a reddish-brown coat in summer and a gray coat in winter. Its tail, which grows to about 1 foot (30 centimeters) long, has brown hair on top and white hair underneath. When the deer is frightened, its tail stands straight up, showing the white part.

Mule deer, also called *black-tailed deer* in the Pacific Northwest, have large, furry ears that look like those of a mule. Mule deer generally live west of the Mississippi River. They also extend north to Alaska and south to central Mexico and the Peninsula of Lower California in Mexico. The mule deer is sometimes called the "jumping deer" because it can jump high in flight and land with all feet on the ground at once.

Central and South American deer include (1) pudu, (2) marsh deer, (3) brocket deer, (4) pampas deer, and (5) huemul.

Pudu, also called *rabbit deer,* are the smallest and shyest of all deer. They live in the forests of western

Some members of the deer family

Common name	Scientific name	Where found
Brocket deer	*Mazama*	North America, South America
***Caribou and *reindeer**	*Rangifer tarandus*	Asia, Europe, and North America
Chinese water deer	*Hydropotes inermis*	Asia
Chital (axis deer)	*Axis axis*	Asia
Fallow deer	*Dama dama*	Asia and Europe
Huemul (Andean deer)	*Hippocamelus*	South America
Marsh deer	*Blastocerus dichotomus*	South America
***Moose**	*Alces*	Asia, Europe, and North America
***Mule deer (black-tailed deer)**	*Odocoileus hemionus*	North America
***Musk deer**	*Moschus moschiferus*	Asia
Père David's deer	*Elaphurus davidianus*	Asia
Pudu	*Pudu*	South America
***Red deer and American elk (wapiti)**	*Cervus elaphus*	Europe, Asia, Africa, and North America
Roe deer	*Capreolus capreolus*	Asia and Europe
White-tailed deer (Virginia deer)	*Odocoileus virginianus*	North America, South America

*Has a separate article in WORLD BOOK.

South America from sea level to altitudes of about 10,000 feet (3,000 meters) in the Andes Mountains. Pudu grow only about 1 foot (30 centimeters) high and weigh about 20 pounds (9 kilograms). They have short, spike-like antlers. Their rough, brittle hair is brown or gray.

Marsh deer, the largest South American deer, live in the swampy plains and forests of Brazil, Paraguay, and Uruguay. They grow about 4 feet (1.2 meters) high. Marsh deer can spread each hoof wide to help them walk on the soft ground. Indians hunt these animals for their skins, but the meat has a poor flavor.

Brocket deer live from Mexico to Paraguay, in wooded areas from sea level to altitudes of 16,000 feet (4,880 meters). They grow about 2.5 feet (75 centimeters) high at the shoulders. Their antlers look like spikes.

Pampas deer are named for the tall pampas grasses of the South American plains in which they live. They grow about 2.5 feet (75 centimeters) high at the shoulders and have reddish-brown or yellowish-brown hair. Glands in the male's back hoofs give off a strong odor.

Huemul, or *Andean deer,* are found in isolated areas of Peru, Argentina, and Chile. They live in grassy plateaus at altitudes of about 16,000 feet (4,880 meters) in the north and in thick coastal forests in the south. Huemul grow to about 3 feet high at the shoulders and have coats of gray, yellow, and brown. The hair is rough and brittle and grows longest on the forehead and tail.

Asian and European deer include (1) musk deer, (2) muntjac, (3) chital, (4) fallow deer, (5) red deer, and (6) Père David's deer.

Musk deer roam the forests of the mountains and high plateaus of central, eastern, and northeastern Asia. They grow to 24 inches (61 centimeters) tall at the shoulders and have no antlers. Two tusklike teeth grow from the top of the jaw. The deer are named for an oily substance called musk, produced by a gland in the male's abdomen. Musk is used in perfume.

Muntjac live in jungle areas in India, Nepal, Sri Lanka, southern China, and throughout most of southeast Asia. They stand about 20 inches (51 centimeters) high at the shoulders. Muntjac are called *barking deer* because they make a barking noise when they are frightened.

Chital, or *axis deer,* live in the grasslands and open forests of India and Sri Lanka. Some people consider them the most beautiful of all deer. Chital grow about 3 feet (90 centimeters) high at the shoulders. Their sleek reddish-brown coats are spotted with white. Their antlers grow about 3 feet long and curve gracefully back from their heads.

Fallow deer live in most parts of Europe. Many are kept in herds on estates or in parks. Fallow deer are about as large as chital. Unlike most European deer, they have broad, flat antlers shaped somewhat like those of a moose.

Red deer live in Europe, Asia, and northern Africa. These animals also live in North America, where they are called American elk. They have reddish-brown to grayish-brown hair and are famous for their beauty.

Père David's deer once roamed the plains and marshes of northern China. They are named for a French priest who first saw the deer in 1865. Today, they only live in private parks and zoos around the world. In 1900, a herd was brought from China to England. The original herd in China died out by 1922, but the English herd survived. Père David's deer stand about 3.5 feet (1.1 meters) high at the shoulders and have a grayish-tan coat in winter and a reddish-tan coat in summer.

Endangered species. In the late 1980's, over 20 species of deer were endangered with extinction. These species included Colombian white-tailed deer, key deer, marsh deer, and five kinds of Asian sikas. Many countries have banned deer hunting and have set up game preserves to protect the animals. Today, destruction of natural habitats poses the greatest threat to deer populations. To create farmland, people have cleared away many areas where deer live. Kenneth J. Raedeke

Scientific classification. Deer are members of the class Mammalia and belong to the order of even-toed hoofed animals, Artiodactyla. They make up the deer family, Cervidae.

Related articles in *World Book* include:

Animal (pictures)	Elk	Musk
Buckskin	Hunting	Musk deer
Caribou	Moose	Red deer
Deer tick	Mule deer	Reindeer

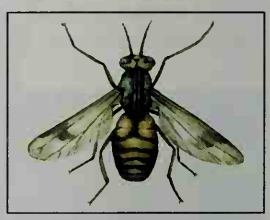
Outline

I. The body of a deer
A. Legs and hoofs B. Head C. Antlers
II. The life of a deer
A. Young B. Food C. Habits
III. Kinds of deer
A. North American deer
B. Central and South American deer
C. Asian and European deer
D. Endangered species

Questions

How many species of deer are there?
What are antlers? How do they grow?
What is a home range?
How far can a deer jump?
What do deer eat?
How many toes does a deer have?
Why does a deer face the wind when it eats or rests?
How do deer avoid enemies?
How old can deer live in the wild?
What are some endangered species of deer?

Deer fly is an insect related to horse flies. Deer flies are found throughout North America. The insects have blotched or banded wings, and some of these wings are beautifully colored. Female deer flies bite large animals and people. Some deer flies carry germs that cause disease. The *snipe fly* is similar to the deer fly and is found in the Western United States. Snipe flies have two wings and six long legs. Some snipe flies have long beaks that are shaped like the bill of a bird called a *snipe.* A person may use mosquito repellents to avoid the bites of both deer flies and snipe flies. E. W. Cupp



WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited

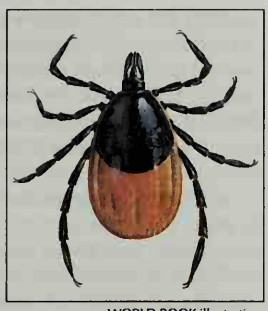
Deer fly

Scientific classification. The deer fly belongs to the horse fly family, Tabanidae. It is in the genus *Chrysops.* Snipe flies belong to the snipe fly family, Rhagionidae.

See also **Horse fly.**

Deer tick is a tiny tick that feeds on the blood of deer, people, and other mammals. Many deer ticks spread an illness called *Lyme disease.* If untreated, this illness may lead to heart and nerve disorders and arthritis in peo-

ple. The *northern deer tick* is a major carrier of Lyme disease. It lives in the northern United States from the Atlantic coast to the Midwest and in parts of southern Canada. It is brown in color and under $\frac{1}{4}$ inch (6 millimeters) long. The northern deer tick spreads Lyme disease when feeding on its victim's blood. It injects bacteria-laden saliva into the victim's body.



WORLD BOOK illustration by John D. Dawson

Northern deer tick

Edwin W. Minch

Scientific classification. Deer ticks belong to the tick family, Ixodidae. The scientific name of the northern deer tick is *Ixodes scapularis.*

See also **Lyme disease; Tick.**

Deere, John (1804-1886), was an American inventor and manufacturer. In 1837, he invented the first steel plow that efficiently turned the American prairie sod. He eventually became one of the world's greatest plow makers.

Deere was born on Feb. 7, 1804, in Rutland, Vermont. He became a blacksmith's apprentice at the age of 17. In 1836, he opened a blacksmith shop in Grand Detour, Illinois. He soon learned that nearby farmers were dissatisfied with their plows. The heavy, sticky prairie sod stuck to the rough surface of the wood or iron moldboard that was used to turn the soil. In addition, most moldboards could not cut through the roots of the heavy grasses that grew on the prairie.

Deere built a smooth, hard moldboard out of an old circular steel saw in 1837. The new moldboard worked just as he had hoped. The soil fell away cleanly from the surface of the moldboard as it turned. Deere and a partner, Leonard Andrus, then began making steel plows. Within 10 years, they were making 1,000 plows annually.

In 1847, Deere sold his interests to Andrus and started a new company in Moline, Illinois. To improve the quality of his plows, Deere ordered a special type of hard steel from England. He then had a similar type of steel made in Pittsburgh, Pennsylvania. This project resulted in the first plow steel ever manufactured in the United States. By 1857, Deere was producing 10,000 plows a year. The business was incorporated as Deere and Company in 1868. Today, the company ranks as one of the largest industrial corporations in the United States.

Douglas E. Bowers

De Falla, Manuel. See Falla, Manuel de.

Defamation. See Libel.

Defense, Civil. See Civil defense.

Defense, Department of, is an executive department of the United States government. The Department of Defense directs the operations of the nation's armed forces, including the Army, Navy, and Air Force.

The department's leaders also advise the president on military matters. The department headquarters are in the Pentagon Building, which is in Arlington, Virginia, near Washington, D.C.

Organization. The Department of Defense is headed by the secretary of defense. The department also includes (1) the Joint Chiefs of Staff, (2) the military departments, and (3) the unified combatant commands.

The secretary of defense is a member of the president's Cabinet. The secretary is a civilian and is appointed by the president with approval of the United States Senate. The secretary's assistants deal with such matters as acquiring and building weapons, developing and protecting military communications systems, gathering intelligence, planning strategy, and preventing the spread of nuclear weapons. The secretary of defense and the assistants of the secretary are supported in their work by a number of agencies of the Department of Defense.

The secretary is a member of the National Security Council and the North Atlantic Council. The National Security Council, part of the Executive Office of the President of the United States, advises the president on a range of security issues. The North Atlantic Council directs the North Atlantic Treaty Organization (NATO), a defense alliance to which the United States belongs. The secretary of defense maintains close contact with top officials in other parts of the United States government, especially the Department of State.

The Joint Chiefs of Staff (JCS) consists of a chairman, a vice chairman, the chiefs of staff of the Army and Air Force, the Navy's chief of naval operations, and the commandant of the Marine Corps. The JCS is the top military staff of the secretary of defense. Members of the JCS serve as military advisers to the president, the National Security Council, and the secretary of defense.

The military departments are the departments of the Army, Navy, and Air Force. The Marine Corps is included in the Department of the Navy. Each military depart-

The seal of the Department of Defense

Secretaries of defense

Name	Took office	Under President
* James V. Forrestal	1947	Truman
Louis A. Johnson	1949	Truman
* George C. Marshall	1950	Truman
Robert A. Lovett	1951	Truman
Charles E. Wilson	1953	Eisenhower
Neil H. McElroy	1957	Eisenhower
Thomas S. Gates, Jr.	1959	Eisenhower
* Robert S. McNamara	1961	Kennedy, Johnson
* Clark M. Clifford	1968	Johnson
* Melvin R. Laird	1969	Nixon
* Elliot L. Richardson	1973	Nixon
James R. Schlesinger	1973	Nixon, Ford
* Donald H. Rumsfeld	1975	Ford
* Harold Brown	1977	Carter
* Caspar W. Weinberger	1981	Reagan
Frank C. Carlucci	1987	Reagan
* Richard B. Cheney	1989	G. H. W. Bush
* Les Aspin	1993	Clinton
* William J. Perry	1994	Clinton
* William S. Cohen	1997	Clinton
* Donald H. Rumsfeld	2001	G. W. Bush

*Has a separate biography in *World Book.*

ment is headed by a civilian secretary who administers the department under the authority, direction, and control of the secretary of defense. The military departments organize, train, equip, and maintain the readiness of their forces.

The unified combatant commands carry out military missions. They consist of large forces from more than one branch of the U.S. military.

History. In 1789, Congress established the Department of War to administer and conduct military affairs. In 1798, Congress separated the naval forces from the land forces, creating the Department of the Navy. The secretaries of both the Department of War and the Department of the Navy were Cabinet members who reported directly to the president.

During World War II (1939-1945), President Franklin D. Roosevelt directed U.S. combat forces through a Joint Chiefs of Staff, which functioned without a formal charter. The United States armed services cooperated with one another through unified commands that operated overseas. But at home, the Army and Navy competed for scarce personnel and materials. The Army Air Forces also pressed for equal status with the Army and Navy.

The National Security Act of 1947 created the National Military Establishment. It was headed by a secretary of defense and had three military departments. The Department of War became the Department of the Army. The Army Air Forces became a separate service under a new Department of the Air Force. The Navy and Marine Corps continued under the Department of the Navy.

The secretary of defense became a member of the Cabinet and formulated general policies and programs for the National Military Establishment. The heads of the military departments also served on the Cabinet. In 1947, Congress formally chartered the Joint Chiefs of Staff.

In 1949, Congress set up the Department of Defense to replace the National Military Establishment. Congress removed the heads of the military departments from the Cabinet and provided that the military departments be administered separately and directed by the secretary of defense. Critically reviewed by the Department of Defense

Related articles in *World Book* include:

Air Force, United States
Army, United States
Flag (picture: Flags of the United States government)
Joint Chiefs of Staff
Marine Corps, U.S.
National Security Agency/Central Security Service
Navy, United States
Pentagon Building

Defense mechanism. See Psychotherapy (Analytic psychotherapy).

Defibrillator, *dee FIHB ruh LAY tuhr* or *dee FY bruh LAY tuhr,* is a medical device used to deliver a brief electrical shock to the heart. The device is used to stop abnormal rhythms during episodes of *arrhythmia* (irregular heartbeat), such as *tachycardia* (rapid heartbeat). These conditions can lead to *ventricular fibrillation* (VF). During VF, the heart *fibrillates* (quivers) uncontrollably, unable to pump blood. VF occurs when the nerve impulses that regulate the heartbeat fire randomly rather than in rhythm. Without immediate treatment, VF leads rapidly to cardiac arrest and death.

External defibrillators consist of two metal paddles or adhesive pads placed on the chest to deliver a shock from a generator to the heart muscle. *Implantable defibrillators* are small, battery-powered devices surgically placed under the skin of the abdomen. Tiny wires connected to the heart enable the device to detect abnormal heart rhythms. If such rhythms are detected, the defibrillator generates a brief electrical shock to stop the heart for a split second. This allows the heart's normal rhythm to resume.

Automated external defibrillators (AEDs) are available in many public buildings, airplanes, and airports for emergency use. These devices can be used by people who have received only a few hours training. AEDs provide opportunities for rapid treatment for victims of sudden cardiac arrest.

Critically reviewed by the American Heart Association

See also **Arrhythmia; Heart** (Abnormal heart rhythms); **Tachycardia.**

Deflation is a decline in the general level of prices in an economy. It is the opposite of *inflation,* in which prices rise. Deflation is rarer than inflation, but its consequences can be more severe.

Each year, about 5 percent of all countries experience deflation. Most of them are less developed nations, and the deflation they experience is brief. However, many industrialized countries, including the United States, the United Kingdom, Japan, Australia, and Canada, have experienced periods of deflation.

Deflation sometimes occurs when an economy undergoes a *depression* or a *recession.* During depressions and recessions, the total output of an economy declines. Depressions are more severe than recessions. The United States experienced sharp deflation during the Great Depression of the 1930's.

Deflation can be caused by competition among producers of goods and services to increase sales by reducing their prices. But weak demand for goods and services is the chief cause of most periods of deflation. During the Great Depression in the United States, several forces acted at once to reduce demand. Banks had little money to lend to qualified individuals and businesses. The Federal Reserve System, the nation's central bank, failed to stimulate the economy by increasing the amount of money in circulation. Also, the federal government sought a balanced budget, which kept it from cutting taxes or increasing spending. All these factors contributed to a decline in demand and thus to deflation. S. Brock Blomberg

See also Inflation.

Defoe, Daniel (1660-1731), was an English novelist and journalist. He wrote *Robinson Crusoe,* one of the first English novels and one of the most popular adventure stories in Western literature. Critics have debated what role he played in the development of the English novel, but he was undoubtedly a great master of realistic narrative and had a remarkable sense of detail in his work.

His life. Defoe was born in London. He was the son of a Protestant butcher and candle merchant. He started a business career, but went bankrupt and turned to writing. Defoe's earliest writings dealt with such controversial subjects as politics and religion. A political pamphlet led to Defoe's imprisonment in 1703 for about 4 months.

For about 25 years, Defoe earned his living as a journalist. He produced his own periodical, *The Review,* single-handedly from 1704 to 1713. Many politicians hired him to write for newspapers. At times he was secretly writing for the Whig Party in one paper and the

Tories in another. Not much is known of his last years, but he continued to write much political journalism, as well as other kinds of work. He died on April 26, 1731.

His writings. Defoe is unusual for the quantity and variety of his works. It is difficult to tell how many works he produced, because most were published anonymously. The latest estimate of Defoe's works is almost 550, including works of poetry, theology, economics, and geography.

For most readers today, Defoe is known primarily as a novelist. However, he did not become a novelist until he was about 60 years old, and novels were really a minor part of his writing. Defoe's two most famous novels are *Robinson Crusoe* (1719) and *Moll Flanders* (1722).

Defoe's novels reflect the growing power and wealth the new English merchant class developed through new business opportunities at home and abroad. Many members of this class were Puritans, and they tended to glorify hard work and getting ahead through one's own efforts. The Puritans also stressed education, and therefore became a large part of the reading public. Defoe was one of the first writers to portray trade, capitalism, and business favorably.

Robinson Crusoe is the story of a man shipwrecked on a desert island. It is presented as though it is Crusoe's actual autobiography. Through his own hard work, inventiveness, and will to succeed, Crusoe turns his island into a thriving colony. See **Robinson Crusoe**.

Moll Flanders has been generally accepted as Defoe's best example of a genuine novel. Moll Flanders, the heroine, is a thief and a prostitute. She later repents of her sins and achieves prosperity. Her surroundings differ from those of Robinson Crusoe, but there are basic similarities between the two characters. Both seem like real people determined to get ahead and gain security. Eventually, they both end prosperously.

Defoe's novels marked an important break with the fiction of the past. He offered the ordinary lives of real people who were the normal products of their social and economic surroundings. Defoe makes us believe in the reality of what we are reading by using concrete, realistic details. But he does not provide much psychological insight into his characters. Gary A. Stringer

De Forest, John William (1826-1906), was an American novelist. He is considered one of the early realists in American fiction. The realists revolted against a romantic, idealized portrayal of life.

De Forest was born on May 31, 1826, in Humphreysville (now Seymour), Connecticut. He spent much time in Charleston, South Carolina, between 1855 and the outbreak of the Civil War in 1861. Soon afterward, he became a captain in the Union Army. De Forest's best novel was *Miss Ravenel's Conversion from Secession to Loyalty* (1867), a realistic treatment of the Civil War. De Forest also wrote *Kate Beaumont* (1872), a novel about South Carolina life, as well as novels about political corruption. His jarring combination of realism and conventional love plots kept him from gaining a wide audience in his day. But his unflinching descriptions of war and keen observations of Southern life before the war foreshadowed later antiromantic developments in American literature. The frank portrayal of soldiers in *Miss Ravenel's Conversion* probably influenced American novelist Stephen Crane in his famous unsentimental war novel *The Red Badge of Courage* (1895). Alan Gribben

De Forest, Lee (1873-1961), was an American inventor who pioneered in the technology of radio and television. In 1907, De Forest patented a three-electrode vacuum tube, which he called an *audion* (see **Vacuum tube**). The audion made it possible to amplify weak radio signals and transmit them over long distances. It was essential for later advances in broadcasting. In 1912, this tube was adapted as an amplifier for long-distance telephone calls.

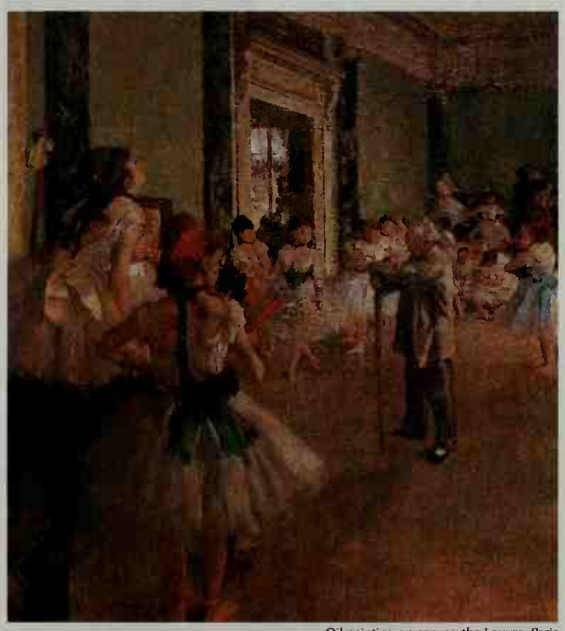
De Forest received a contract from the United States Navy to build radio stations for ship-to-shore communications. He also staged demonstrations of radio's potential to entertain the public. In 1910, he arranged to broadcast a performance by tenor Enrico Caruso from the Metropolitan Opera House in New York City.

During the 1920's, De Forest worked on a sound system for motion pictures. After 1930, he turned his attention to television's emerging technology. After the U.S. government authorized commercial telecasting in 1941, he encouraged the use of the new medium for public entertainment. De Forest was born on Aug. 26, 1873, in Council Bluffs, Iowa. Joseph H. Udelson

See also **Electronics** (picture: The vacuum tube amplifier).

Degas, *duh GAH,* **Edgar** (1834-1917), was a French impressionist painter. Like the other impressionists, he wanted to portray situations from modern life. However, he did not share his fellow impressionists' concentration on light and color. Degas emphasized composition, drawing, and form more than did the other members of the movement. See **Impressionism**.

Degas is best known for his paintings of people in both public and unguarded private moments. He showed his figures in awkward or informal positions to free himself from what he felt were outmoded styles of portraying the human body. But he composed his pic-



Oil painting on canvas; the Louvre, Paris

Edgar Degas painted *The Dancing Class* in 1874.

tures carefully both for formal balance and to indicate the social interaction of his figures.

Hilaire Germain Edgar Degas was born on July 19, 1834, in Paris. His parents were wealthy. From 1854 to 1859, he spent much time in Italy studying the great Italian Renaissance painters to perfect his draftsmanship and style. Degas intended to become a painter of historical scenes, but he abandoned this career because he felt a need to paint modern subjects. Probably under the influence of the painters Gustave Courbet and Edouard Manet, Degas began to paint scenes from everyday life. He especially enjoyed painting pictures of race-track and theatrical life.

During the 1870's, Degas began to use daring compositional techniques, partly influenced by Japanese prints. He placed his figures at unusual angles and used odd visual viewpoints. For example, he tilted his perspective to emphasize a sudden or informal movement by a figure. He even cut off parts of the subjects at the edge of the picture. In the 1880's, Degas started to concentrate on intimate scenes, such as women bathing, shopping, or drying or combing their hair.

Degas painted many pictures in oil, but he also excelled in pastel. In addition, Degas was a fine sculptor and made many clay or wax figurines. Richard Shiff

See also Cassatt, Mary (picture).

De Gaulle, *duh GOHL* or *duh GAWL,* **Charles André Joseph Marie** (1890-1970), became the outstanding French patriot, soldier, and statesman of the 1900's. He led French resistance against Germany in World War II, and restored order in France after the war. He guided the formation of France's Fifth Republic in 1958, and served as its president until his resignation in 1969.

Wide World

Charles de Gaulle

As president of France, de Gaulle led his country through a difficult period in which Algeria and other parts of France's overseas empire were granted independence. He fashioned a new role in Europe for France based on close association with a former enemy, Germany. His leadership restored political and economic stability, and again made France one of Europe's leading powers. De Gaulle provided France with a successful constitution, political system, and foreign policy.

Charles de Gaulle became a symbol of France to the French and to people in other parts of the world. Even his name suggested *Gaul,* the ancient Roman name for an area that is now mainly France. An imposing figure 6 feet 4 inches (193 centimeters) tall, de Gaulle was stern and aloof. Some thought him stubborn and arrogant. But de Gaulle had a deep love for France and great confidence in himself. He firmly believed that he was the one man who could make France a world power again.

Early life. Charles de Gaulle was born Nov. 22, 1890, in Lille. His father, Henri, was an officer in the Franco-Prussian War, then taught philosophy, literature, and mathematics. His mother, Jeanne Maillot de Gaulle, came from a literary and military family.

With his sister and three brothers, Charles grew up in an atmosphere that was both military and religious. As a boy, he enjoyed reading stories of famous French battles. When he played soldiers with his friends, Charles always had to be "France." After studying at the College Stanislas in Paris, de Gaulle served a year in the infantry. He graduated with honors in 1911 from the famous French military school, St. Cyr.

During World War I, de Gaulle was wounded four times. He was captured at Verdun in 1916. After the war, he served with the French Army in Poland, then taught military history at St. Cyr for a year.

In 1921, he married Yvonne Vendroux, a devout Roman Catholic. They had a son and two daughters. Yvonne de Gaulle followed her husband wherever his duties took him, but essentially remained behind the scenes as a housewife and mother.

Between World Wars I and II, de Gaulle held various military commands and taught at the French War College. His book *The Edge of the Sword* (1932) stressed the importance of powerful leadership in war. In *The Army of the Future* (1934), he outlined the theory of a war of movement, in which tanks and other mechanized forces would be used. Most French military leaders ignored this theory. But the Germans studied it and used it in World War II.

Leader of the Free French. After the Germans invaded France in May 1940, de Gaulle was put in charge of one of France's four armored divisions. He became undersecretary for war in June. But just days later, on June 22, France surrendered to Germany.

De Gaulle, then a general, escaped to London. He refused to accept the surrender. Nor would he recognize the authority of Marshal Pétain, his former regimental commander and patron, who headed the Vichy government that cooperated with the Germans (see **Pétain, Henri Philippe**). For this, a French military court sentenced de Gaulle to death. De Gaulle declared that France had lost a battle but not the war. He broadcast such messages to France as: "Soldiers of France, wherever you may be, arise!" His broadcasts stirred French patriotism and kept French resistance alive.

De Gaulle organized the Free French forces in the United Kingdom and in some of the French colonies. In September 1941, he became president of the French National Committee in London. By 1943, the Allies accepted de Gaulle as the unquestioned leader of the "Fighting French."

Peacetime leader. De Gaulle triumphantly entered Paris with the Allies in August 1944. In September, he became head of the provisional government.

De Gaulle got the machinery of government working again during the next 14 months. But France's left-wing parties did not support him, and he resigned in January 1946. He bitterly opposed the constitution of 1946 because it did not provide a strong executive power. In 1947, he organized a new party, the Rally of the French People (R.P.F.) to reform the constitution. But it lost strength after the elections of 1951 and 1956.

He lived at his country home during his retirement. He wrote his World War II memoirs and watched the political situation in France go from bad to worse. In 1957, though he was 67, de Gaulle still hoped that

France would recall him. But early in 1958 he admitted, "Now I begin to fear that it is too late."

The Fifth Republic. Finally, in May 1958, the call came. France stood on the verge of civil war. Dissatisfied French officers, afraid they would lose the government's support against the Algerian rebels, seized power in Algiers. De Gaulle emerged as the only figure likely to prevent domestic chaos. In June, he accepted President René Coty's request to form a government on the condition that he have full powers for six months.

De Gaulle had a new constitution drawn up that established the Fifth Republic. It provided broad powers for the president, who was to be elected for seven years by an electoral college of 80,000 public officials. French voters approved the plan, and the electoral college chose de Gaulle as president in December 1958.

As president, de Gaulle acted with great firmness. After another revolt in Algeria in 1960, he arrested French officers there who had formerly supported him. He negotiated with Algerian nationalist leaders for a cease-fire agreement. The agreement they reached in March 1962 ended more than seven years of bloody war. At de Gaulle's urging, the French people voted almost 10 to 1 in April 1962 for Algerian independence.

The French Assembly ousted the de Gaulle-sponsored government in October 1962. But de Gaulle dissolved the Assembly and obtained the support of a majority coalition. In a separate referendum, the voters also approved de Gaulle's proposal to elect future French presidents by direct popular vote.

In January 1963, de Gaulle and Chancellor Konrad Adenauer of West Germany signed a treaty providing for political, scientific, cultural, and military cooperation. At the same time, de Gaulle blocked the United Kingdom's entry into the European Economic Community (EEC). In 1964, France became the first Western power to recognize Communist China. De Gaulle narrowly won a second seven-year term as president in 1965. In 1966, he decided to withdraw French forces from the North Atlantic Treaty Organization (NATO) and remove NATO headquarters from France. In 1967, de Gaulle again blocked the entry of the British into the Common Market. He also created an independent nuclear strike force and criticized U.S. involvement in the Vietnam War (1957-1975).

In 1968, French students and workers staged strikes and demonstrations. The economy suffered from inflation and currency problems, but de Gaulle maintained popular support. In April 1969, however, his proposals for constitutional changes were defeated in a referendum, and he resigned. De Gaulle died on Nov. 9, 1970, after suffering a heart attack. Michael M. Harrison

Additional resources

Lacouture, Jean. *De Gaulle.* 2 vols. 1990, 1992. Reprint. Norton, 1993.

Whitelaw, Nancy. *A Biography of General Charles de Gaulle.* Dillon Pr., 1991. Younger readers.

De Grasse, *duh GRAHS,* **François Joseph Paul,** *frahn SWA zhoh ZEHF* (1722–1788), also known as Comte (Count) de Grasse, was a French admiral. He aided General George Washington at the siege of Yorktown in the Revolutionary War. De Grasse commanded the French fleet that drove the British Navy away from the Virginia coast and cut off General Charles Cornwallis from aid or retreat (see Revolutionary War in America [Surrender at Yorktown]). De Grasse later was defeated and captured by the British in the West Indies. He returned to France in disgrace. De Grasse was born on Sept. 13, 1722, near the city of Toulon, France. James H. Hutson

Degree is a name given to various small units of measure. In geometry and on maps, a degree is a unit of measurement of angles and of arcs of circles. An angle of 1 degree (1°) is $\frac{1}{90}$ of a right angle. An arc of 1° is $\frac{1}{360}$ of a whole circle. Because longitude and latitude lines are circles, they are also measured in degrees. Degrees in geometry are divided into 60 units called *minutes.* Some branches of higher mathematics measure angles in units called *radians.* See **Angle; Circle; Latitude; Longitude; Minute; Radian; Second.**

Degrees are also units of measurement of temperature. One degree of temperature on the Fahrenheit scale is $\frac{1}{180}$ of the difference between the temperatures of melting ice and boiling water. One degree on the Celsius scale of temperature is $\frac{1}{100}$ of the same difference. See **Thermometer.** Colin C. Graham

Degree, College. A university or college awards a *degree* to a person who has completed a required course of study. The institution presents the degree in the form of a *diploma,* a document certifying the award. The four basic kinds of degrees are called *associate's, bachelor's, master's,* and *doctor's.* An honorary degree may be awarded for an outstanding contribution in a field.

The associate's degree is awarded by many U.S. colleges and universities and most community, or junior, colleges (see **Community college**). It usually indicates completion of two years of college work. The most commonly awarded associate's degrees are the *Associate in Arts* and the *Associate in Science.*

The bachelor's degree. In the United States, a college student normally receives a bachelor's degree after four years of study in a university or college. Most students specialize in a field of study called a *major subject.* Many institutions require other types of study outside a major to ensure a liberal education. There are many kinds of bachelor's degrees, but the two most common are the *Bachelor of Arts* (*B.A.*) and the *Bachelor of Science* (*B.S.*). The B.A. usually includes majors in such subjects as history, literature, and fine arts, and, in certain cases, science and mathematics. The B.S. usually includes majors in the physical and natural sciences. Most engineering students receive B.S. degrees. Many colleges offer specialized degrees, such as the *Bachelor of Education* or *Bachelor of Architecture.* Law students obtain the *Doctor of Jurisprudence* (*J.D.*) after more training. Outstanding achievement in a bachelor's degree may be designated by the Latin phrases *cum laude* (with praise), *magna cum laude* (with great praise), or *summa cum laude* (with the highest praise).

British colleges and universities offer two types of bachelor's degrees, an ordinary, or *pass,* degree and an *honors* degree which requires more extensive and more advanced work. Canadian colleges and universities usually follow British or French tradition in their systems of degrees. See **Canada** (Education).

The master's degree. In the United States, students who desire a master's degree must complete one or two years of advanced study beyond the bachelor's degree. Many institutions require a *thesis,* a written report

Some common abbreviations for college degrees

A.A. Associate in Arts

A.S. Associate in Science

B.A., A.B. Bachelor of Arts

B.A. in Ed. Bachelor of Arts in Education

B.Arch. Bachelor of Architecture

B.B.A. Bachelor of Business Administration

B.D. Bachelor of Divinity

B.Ed. Bachelor of Education

B.E.E. Bachelor of Electrical Engineering

B.F.A. Bachelor of Fine Arts

B.L.S. Bachelor of Library Science

B.M., B.Mus. Bachelor of Music

B.M.E., B.Mus.Ed. Bachelor of Music Education

B.S. Bachelor of Science

B.S. in B.A., B.S.B.A. Bachelor of Science in Business Administration

B.S. in C.E., B.S.C.E. Bachelor of Science in Civil Engineering

B.S. in Ch.E., B.S.Ch.E. Bachelor of Science in Chemical Engineering

B.S. in Chemistry, B.S. Chem. Bachelor of Science in Chemistry

B.S. in Ed., B.S.Ed. Bachelor of Science in Education

B.S. in E.E., B.S.E.E. Bachelor of Science in Electrical Engineering

B.S. in Elem.Ed. Bachelor of Science in Elementary Education

B.S. in L.S. Bachelor of Science in Library Science

B.S. in M.E., B.S.M.E. Bachelor of Science in Mechanical Engineering

B.S. in Med.Tech. Bachelor of Science in Medical Technology

B.S.J., J.B.S. Bachelor of Science in Journalism

B.S.N. Bachelor of Science in Nursing

B.S.Pharm. Bachelor of Science in Pharmacy

D.A. Doctor of Arts

D.B.A. Doctor of Business Administration

D.C. Doctor of Chiropractic

*D.D. Doctor of Divinity

D.D.S. Doctor of Dental Surgery

D.M.D. Doctor of Dental Medicine

*D.Mus., Mus.D. Doctor of Music

D.O. Doctor of Osteopathy

D.V.M. Doctor of Veterinary Medicine

Ed.D., D.Ed. Doctor of Education

J.D. Juris Doctor

*L.H.D. Doctor of Humane Letters

*Lit.D., D.Lit. Doctor of Literature

*Litt.D. Doctor of Letters

LL.B Bachelor of Laws

*LL.D. Doctor of Laws

LL.M. Master of Laws

M.A., A.M. Master of Arts

M.A. in Ed. Master of Arts in Education

M.A.T. Master of Arts in Teaching

M.B.A. Master of Business Administration

M.D. Doctor of Medicine

M.Div. Master of Divinity

M.Ed. Master of Education

M.F.A. Master of Fine Arts

M.L.S. Master of Library Science

M.M., M.Mus. Master of Music

M.M.Ed., M.Mus.Ed. Master of Music Education

M.R.E. Master of Religious Education

M.S. Master of Science

M.S. in C.E., M.S.C.E. Master of Science in Civil Engineering

M.S. in Ch.E. Master of Science in Chemical Engineering

M.S. in Ed. Master of Science in Education

M.S. in E.E., M.S.E.E. Master of Science in Electrical Engineering

M.S. in L.S. Master of Science in Library Science

M.S. in M.E. Master of Science in Mechanical Engineering

M.S.J. Master of Science in Journalism

M.S.W. Master of Social Work

Ph.B. Bachelor of Philosophy

Ph.D. Doctor of Philosophy

†Sc.D., D.Sc., D.S. Doctor of Science

S.T.M. Master of Sacred Theology

Th.M. Master of Theology

*Honorary degree only. †Usually honorary.

of a special investigation in the student's major field. The two most common master's degrees are the *Master of Arts* and the *Master of Science*.

In the United Kingdom, the master's degree is usually considered the highest requirement for an academic career. However, a number of British universities also offer the doctorate. In Scotland, a student proceeds directly to the master's degree without taking a bachelor's degree.

The doctor's degree is the highest earned degree in the United States, France, Germany, and many other countries. There are two distinct types of doctor's degrees. One is a professional degree required to practice in certain professions, such as medicine. The other is a research degree that indicates the candidate has acquired mastery of a broad field of knowledge and the technique of scholarly research.

In the United States, the research doctorate requires at least two or three additional years of study beyond the master's degree. Most doctoral students are expected to have a reading knowledge in two foreign languages. The candidate must also complete examinations and present a written thesis or *dissertation*. The doctoral thesis represents an original contribution to knowledge, and is a more detailed study of a research problem than that required for the master's degree.

The *Doctor of Philosophy* degree is the most important research doctorate and may include specialization in almost any academic subject. The *Doctor of Education, Doctor of Medicine,* and *Doctor of Dental Surgery* degrees represent advanced professional training. Students in such professions as medicine and dentistry can obtain a doctor's degree without first receiving a bachelor's or master's degree. But most acquire a bachelor of science degree before entering medical training.

Honorary degrees. Many award honorary degrees to people for achievement in their chosen fields. Chief among these are the *Doctor of Letters* and the *Doctor of Laws*. These are given to prominent authors, scholars, and leaders in the professions, business, government, and industry.

History. College degrees date from the 1200's when schools in Europe won the right to examine and license their graduates. The system of degrees, which took form by the 1300's, was modeled on the guild system. A student spent a sort of apprenticeship as a candidate for a bachelor's degree. Receiving the bachelor's degree resembled becoming a journeyman in a craft. The master's degree represented the status of a master craftsman, and served as a license to teach. The student's thesis was his "masterpiece," just as a journeyman submitted an example of his work to become a master craftsman. If the student continued to study and teach in law, medicine, or theology, he might earn the title of doctor. The medieval system remained largely unchanged until the impact of science on education in the 1700's and 1800's. During the last hundred years, college degrees in the United States have been extended to include many new fields of knowledge. Douglas Sloan

See also **Graduation**.

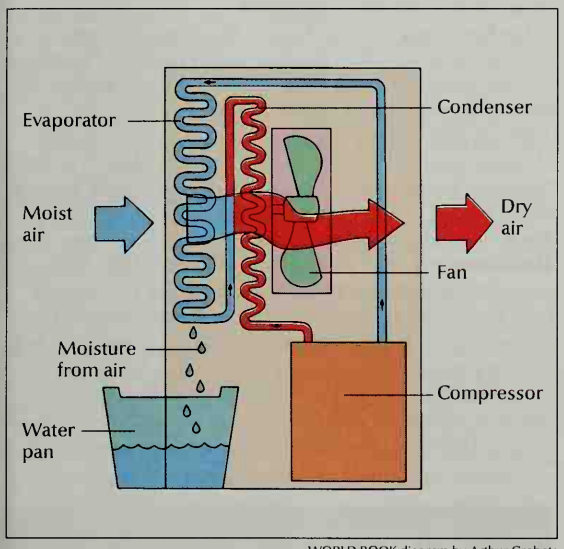
De Groot, Huig. See Grotius, Hugo.

De Hooch, *duh HOHK,* **Pieter,** *PEE tuhr* (1629-1684?), was a Dutch painter noted for his charming scenes of middle-class life. He painted housewives with maids or children, and ladies and gentlemen talking, drinking, or playing games. His style is distinguished by warm, often unmixed colors and the skillful portrayal of the effects of sunlight. Like other Dutch painters of his time, de Hooch experimented with showing depth and the illusion of space. Unlike earlier Dutch painters of everyday life, he often included glimpses through the open doors or windows into rooms, streets, or gardens. De Hooch and Jan

Vermeer, another Dutch painter of the 1600's, probably influenced each other. De Hooch was born on Dec. 20, 1629, in Rotterdam. Linda Stone-Ferrier

Dehumidifier, *dee hyoo MIHD uh fy uhr,* is a device that removes moisture from the air. Dehumidifiers are commonly used to make homes more comfortable.

Warmer air can contain more moisture than cooler air can. On hot days, this additional moisture can make people uncomfortable. However, reducing the amount of moisture in the air makes moisture on the skin evaporate more readily. People then feel cooler, even though the air temperature stays the same. Lowering the moisture level of the air also helps prevent the growth of mold and mildew in the home.



WORLD BOOK diagram by Arthur Grebetz

A dehumidifier removes moisture from the air. The fan draws in moist air, which loses its moisture as it passes over the evaporator. The air is reheated by the condenser, and then released.

A dehumidifier consists of a set of cold coils, called the *evaporator,* and a set of hot coils, the *condenser.* A fan in the dehumidifier draws moist air from a room and blows it across the coils. The air loses moisture as it passes over the evaporator, and it is reheated to room temperature by the condenser. The air then reenters the room, absorbs moisture again, and recirculates through the dehumidifier. The moisture lost by the air is carried by a hose to a drain or sink, or it is collected in a built-in container. Evan Powell

See also **Air conditioning** (Controlling the moisture); **Humidifier; Humidity.**

Dehydrated food is food that has been preserved by drying. Adding water to such food makes it ready for eating or for cooking. Dried milk and milk products, soups, coffee, tea, spices, gelatin, dessert mixes, and macaroni are sold in most stores. Other common dehydrated foods include yeast, cheese, and egg products.

Important features of dehydrated foods are their lightness in weight and their compactness. Over 90 percent of the water is removed during drying. When adequately packaged, most dehydrated foods can be kept for several months if stored below 75 °F (24 °C).

Foods selected for drying must be fresh, clean, and at the proper stage of ripeness. Vegetables are usually *blanched* (briefly heated and cooled) to destroy enzymes before drying. Biological products such as serums and vaccines and such foods as chickens and mushrooms are freeze-dried. In the freeze-drying process, the product is frozen and held under conditions of low heat and a nearly perfect vacuum. As a result, the ice in the frozen food is vaporized without melting. H. Jack Warner

See also **Food preservation** (Drying).

Dehydration is a condition characterized by the excessive loss of water from the body. In most cases of dehydration, the body also loses salt. Symptoms of mild dehydration include dryness of the mucous membranes of the nose, mouth, and throat; reduced ability to sweat and urinate; and doughy skin. In severe dehydration, rapid loss of salt and water leads to fast heartbeat, low blood pressure, shock, and even death.

Worldwide, the most common cause of dehydration is infectious diarrhea. Dehydration resulting from diarrhea is a major cause of death in children in developing countries. Other causes include vomiting, excessive sweating or urination, and extensive skin burns. Extended shortages of water may also produce dehydration. Some people in comas may become dehydrated because they are unable to respond to thirst.

People suffering from mild dehydration should drink plenty of fluids. Cases of severe dehydration usually require hospitalization. In treating diarrhea-related dehydration, doctors use a solution containing glucose to restore lost water and salt. This solution may be taken orally or by injection. Laurence H. Beck

Deighton, *DAY tuhn,* **Len** (1929-), is an English author known for espionage and war novels. He belongs to the antiromantic school of spy novelists, presenting espionage as an unglamorous and ruthless activity. He carefully researches his novels. He often uses footnotes and other scholarly devices to reflect his research and make his stories appear more realistic. A typical Deighton novel has a complicated plot and many details.

Deighton gained international recognition for his first spy thriller, *The Ipcress File* (1962). The novel introduces the anonymous British spy who narrates most of Deighton's novels. The story has a complicated plot involving the kidnapping of British biochemists. Deighton has written two trilogies and a separate novel about British spy Bernard Samson. The first trilogy consists of *Berlin Game* (1983), *Mexico Set* (1985), and *London Match* (1985). Next came *Winter* (1987) and the second trilogy, *Spy Hook* (1988), *Spy Line* (1989), and *Spy Sinker* (1990). His other novels include *Funeral in Berlin* (1964), *Bomber* (1970), *Close-Up* (1972), *SS-GB* (1978), and *XPD* (1981).

Deighton also has written popularized military history, including *Blitzkrieg* (1979) and *Battle of Britain* (1980). He was born on Feb. 18, 1929, in London. After World War II ended in 1945, he served in the Special Investigations branch of the Royal Air Force. Michael Seidel

Deinonychus, *dy NAHN ih kuhs,* was a small, meat-eating dinosaur. It grew about 9 feet (2.7 meters) long, stood about 5 feet (1.5 meters) tall, and weighed approximately 150 pounds (70 kilograms). The dinosaur walked and ran on two hind legs, using its long, stiff tail for balance.

Deinonychus had a body well suited for hunting. The animal's head possessed large eyes, powerful jaws, and sharp serrated teeth. Its teeth curved backward and could easily chew up prey. The dinosaur also had elongated arms and long, slender fingers to grasp its victims. On each foot grew a long bladelike claw, which *Deinonychus* used to tear prey apart. These claws measured about 5 inches (12.5 centimeters) in length. They give the dinosaur its name, which means *terrible claw. Deinonychus* probably hunted in packs in order to kill larger animals.

Deinonychus lived about 110 million to 100 million years ago, during the Cretaceous Period. Scientists have found its remains in the western United States.

Kenneth Carpenter

See also **Dinosaur** (picture: When dinosaurs lived).

Deism, *DEE ihz uhm,* is a religious and philosophic belief. Deism rejects most conventional forms of religion, accepting reason as the only guide to truth. It embraces the concept of God, however, in the limited sense of a creator, or first cause, of the physical and moral laws of the universe. Deists compare God's act of creation to that of a watchmaker who builds a watch, sets it in motion, and then refuses to intervene in its actions.

Deism became popular during the 1700's. Deist ideas appear in the writings of such philosophers as Jean-Jacques Rousseau and Voltaire of France and Immanuel Kant of Germany. In America, deist ideas appear in the Declaration of Independence and the Preamble to the Constitution. Those ideas reflect the political influence of leading deists of the time: Benjamin Franklin, Thomas Jefferson, and Thomas Paine. The deist concept of God underlies such phrases as "In God We Trust" and "we are endowed by the Creator with certain inalienable rights."

Mark Juergensmeyer

See also **God; Theism; Atheism.**

De Kalb, Johann. See Kalb, Johann.

Dekker, Thomas (1572?-1632?), brought to Elizabethan popular literature a fresh emphasis on the life of his day. Dekker's best-known play is *The Shoemaker's Holiday* (1599). It is a zestful picture of Elizabethan life that combines patriotism and romance with a favorable portrayal of the rising merchant and artisan classes. Dekker's other plays include the romance *Old Fortunatus* (1599) and the comedy *The Honest Whore* (1604-1605).

Dekker wrote many dramas and pamphlets. Between 1598 and 1602 alone, he wrote all or part of over 40 plays, most of them now lost. Yet he usually had no money and apparently spent several years in prison for debt. From about 1604, Dekker turned increasingly to writing popular pamphlets, mainly satires of the London underworld. *The Gull's Hornbook* (1609) is a lively record of London life of the time.

Stephen Orgel

De Klerk, *duh KLEHRK,* **Frederik Willem,** *FREH dehr ihk VIHL uhm* (1936-), was head of South Africa's government from 1989 to 1994. He played a major role in helping the country's black majority gain control of the government. South Africa had long been ruled by its white minority.

South Africa's white rulers had established a policy of racial segregation called *apartheid* along with their system of white-minority rule. Under this policy, blacks were not allowed to vote. As president, de Klerk was a major force in ending apartheid and giving blacks the right to vote. The first elections in which blacks could vote were held in April 1994. Blacks won control of Parliament. Parliament chose black leader Nelson Mandela as president and de Klerk as deputy president. De Klerk and Mandela won the 1993 Nobel Peace Prize for working to end apartheid and to give nonwhites full participation in government. In 1996, de Klerk resigned.

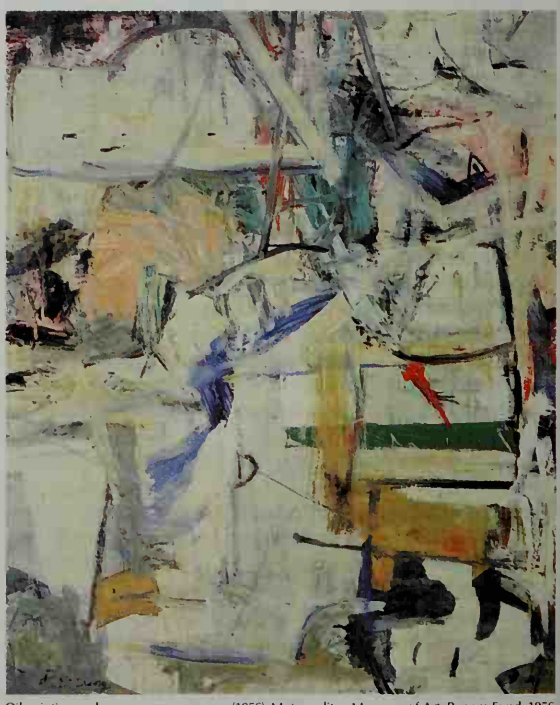
© Mark Peters, Sipa

Frederik W. de Klerk

De Klerk was born on March 18, 1936, in Johannesburg in what was then the Transvaal Province. He attended Potchefstroom University and then practiced law. De Klerk served in South Africa's Parliament from 1972 to 1989. He became a member of the South African national government's Cabinet in 1978. In 1989, State President Pieter W. Botha, South Africa's leader, resigned because of ill health. De Klerk replaced him as state president. De Klerk was elected to the post later in 1989.

Bruce Fetter

De Kooning, *duh KOO nihng,* **Willem** (1904-1997), was a leading abstract expressionist artist. He became best known for his hectic and violent paintings dominated by lunging brushstrokes, swirling paint patterns, and a strong emphasis on line. In later works, de Kooning simplified the surfaces of his paintings, sometimes working with purely linear patterns on coated, white canvas. However, the mood of de Kooning's paintings



Oil painting and newspaper on canvas (1956); Metropolitan Museum of Art, Rogers Fund, 1956

A Willem de Kooning painting called *Easter Monday* is typical of the abstract style the artist developed in the mid-1950's. This style featured short, broken brushstrokes and bright colors.

and drawings is not always explosive. In his early tender portraits, his studies of women during the 1960's, and other works, he showed skill with refined, delicate compositions and colors.

De Kooning was born on April 24, 1904, in Rotterdam, the Netherlands. He moved to the United States in 1926. He gained his first critical acclaim for his abstract paintings of the late 1940's. Painted largely in black and white enamel, these pictures are composed of rhythmic curved lines mixed with oddly shaped flat planes. In 1953, de Kooning exhibited a series of oils and pastels titled *Woman* in which he appeared to present a primitive vision of woman as siren or dark goddess. *Woman, I,* from this series, is shown in the **Painting** article. The exhibition inspired many younger artists to seek new ways of interpreting the human figure. Many later de Kooning paintings contain landscape elements and suggest huge spaces and outdoor light. Dore Ashton

Delacroix, *duh lah KRWAH,* **Eugène,** *oo ZHEHN* (1798-1863), was the chief representative of the romantic style of painting in France. Like many romantics, he painted exotic, faraway, emotional subjects. His painting was influenced by Flemish painter Peter Paul Rubens's bold, thick brushstrokes and the deep, rich colors of the Venetian Renaissance painters.

Delacroix admired the English writers William Shakespeare and Lord Byron, whose work provided subjects for his paintings. Delacroix's sympathy for the Greeks' struggle for independence from Turkey inspired him to paint *Incidents from the Massacre at Chios* (1824). In 1830, Delacroix took part in a revolution in Paris that freed France from an absolute monarchy. His painting *Liberty Leading the People* (1830) glorifies this event.

In 1832, Delacroix traveled to North Africa, where the effects of the intense sunlight led to his use of shimmering color highlights. The sketches of exotic people, animals, and events he made in Africa became subjects for many of his later paintings, starting with *The Women of Algiers* (1834). Ferdinand Victor Eugène Delacroix was born on April 26, 1798, at Charenton, near Paris.

Ann Friedman

See also **Greece** (History); **Painting** (The 1800's; picture: *The Women of Algiers*).

De la Madrid Hurtado, *day lah mah DREED ur TAH doh,* **Miguel,** *mih GEHL* (1934-), served as the president of Mexico from 1982 to 1988. De la Madrid is a member of the Institutional Revolutionary Party. A financial expert, de la Madrid served as Mexico's secretary of planning and budget from 1979 until he became president of the country. When de la Madrid became president of Mexico, he faced severe economic problems that resulted from government spending and reduced income from oil. As president, he took steps to try to solve the problems, including inflation and a huge foreign debt. But the problems continued, and de la Madrid's critics charged him with a lack of leadership.

De la Madrid was born on Dec. 12, 1934, in Colima. He received a law degree from the National Autonomous University of Mexico in 1957. He taught there from 1958 to 1968. In 1964 and 1965, he took a leave of absence to earn a master's degree in public administration at Harvard University. He entered government service in 1960. Before becoming a Cabinet member, he served in government financial posts in the department of the Treasury and with Mexico's national oil company.

Roderic A. Camp

De la Mare, *duh luh MAIR,* **Walter** (1873-1956), was an English author noted for his romantic works for both adults and children. He wrote poems, short stories, novels, and plays distinguished by a unique mixture of dreams, reality, and the supernatural. De la Mare also edited books for children. His anthology of prose and verse called *Come Hither* (1923) is a children's classic. De la Mare's best collections of poetry include *Peacock Pie* (1913) and *Bells and Grass* (1942). His most popular short stories were published in *Collected Stories for Children* (1947). Perhaps his best-known work for adults is the novel *Memoirs of a Midget* (1921). It is a romantic fantasy about society as seen through the eyes of a midget. Walter de la Mare was born on April 25, 1873, in Charlton, near London. See also **Regina Medal.**

Jerome Bump

Delany, *duh LAY nee,* **Martin Robinson** (1812-1885), was a black American army officer, physician, journalist, and social reformer. He was trained as a physician at Harvard University. He practiced medicine occasionally in Pittsburgh but spent most of his time fighting against slavery. He worked for the *Underground Railroad,* a system for helping slaves escape to the North before the American Civil War (1861-1865). He also wrote for an abolitionist newspaper owned by the black crusader Frederick Douglass. In the 1850's, Delany joined a movement that urged free blacks to move to Africa. But Delany later lost his enthusiasm for this "back-to-Africa" movement.

Historical Picture Service, Inc., Chicago

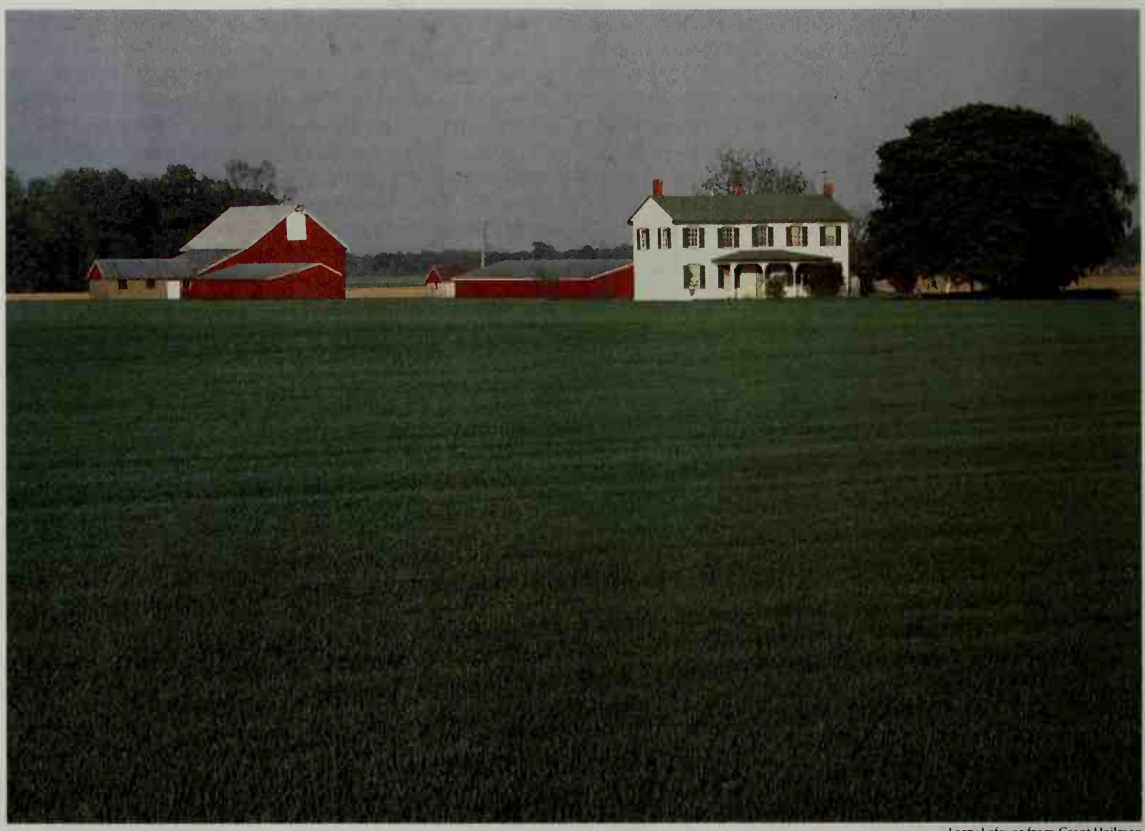
Martin Delany

Delany served as a Union Army surgeon during the Civil War. He became the first black to earn the rank of major. Delany was born on May 6, 1812, in Charles Town, West Virginia (then part of Virginia).

Richard Bardolph

De la Roche, *duh luh RAWSH,* **Mazo,** *MAY zoh* (1879-1961), became one of the most popular novelists in Canadian literature. She was best known for a series of 16 novels about the Whiteoak family. The first Whiteoak novel was *Jalna* (1927), and the last was *Morning at Jalna* (1960). These novels tell the story of several generations of the family from 1852 to 1954. The central character is Adeline Whiteoak, who emigrates with her husband from the United Kingdom to Canada. She builds a home called Jalna in the countryside west of Toronto and dominates the lives of the family members who live there. The books create a vivid picture of upper-class life on a country estate. The Jalna saga was made into a successful Canadian Broadcasting Corporation television series in 1972. De la Roche also wrote other novels, as well as plays, short stories, and an autobiography called *Ringing the Changes* (1957). De la Roche was born on Jan. 15, 1879, in Newmarket, Ontario. Laurie R. Ricou

De la Salle, Saint Jean Baptiste. See Jean Baptiste de la Salle, Saint.



Larry Lefever from Grant Heilman

A crop of Delaware barley grows on a farm west of Dover, in the central section of the state. Farmland covers about half of Delaware. Most of Delaware lies in the Atlantic Coastal Plain, a region of flat, fertile land.

Delaware *The First State*

Delaware is the second smallest state of the United States. Only Rhode Island has a smaller area. And only five states—Alaska, North Dakota, South Dakota, Vermont, and Wyoming—have fewer people. Delaware lies close to many of the nation's largest industrial cities. The Delaware River, and networks of canals, highways, and railroads, carry products from Delaware to Baltimore, New York City, Philadelphia, and Washington, D.C.

Delaware lies along the Atlantic coastline. It shares the Delmarva Peninsula with parts of Maryland and Virginia. Most of Delaware lies in a low, flat, coastal plain. Rolling hills and valleys of the Piedmont region cover the northern tip of the state.

About 200,000 companies are incorporated in Delaware. They include many of the largest U.S. firms. Delaware's business laws favor corporations. It is easier and less expensive to incorporate in Delaware than in most other states—even for companies that do most of their business outside of Delaware. Several of the nation's biggest chemical companies have headquarters and research laboratories in or near Wilmington, the state's largest city. These firms include E. I. du Pont de Nemours & Company, one of the world's largest chemical manufacturers and marketers. Wilmington is also one of the nation's leading banking centers. Dover is the capital of Delaware.

Broilers (chickens from 5 to 12 weeks old) are the leading cash farm product in Delaware. Broiler raising has made Sussex County in the southern part of Delaware one of the nation's richest farm regions.

In 1609, Henry Hudson, an English explorer sailing for the Netherlands, reached what is now Delaware. In 1610, a ship from the Virginia colony sailed into what is now called Delaware Bay. The captain named the bay *De La Warr Bay* for Lord De La Warr, the governor of Virginia. Delaware is known as the *First State,* because on Dec. 7, 1787, it became the first state to *ratify* (approve) the United States Constitution.

Delaware is the only state in which counties are divided into areas called *hundreds.* Delaware is also the only state in which the legislature can amend the state Constitution without the approval of the voters.

The contributors of this article are Barbara E. Benson, Executive Director of the Library of the Historical Society of Delaware; and Peter W. Rees, Associate Professor of Geography at the University of Delaware.

Interesting facts about Delaware

WORLD BOOK illustrations by Kevin Chadwick

Christmas seals were first introduced to the United States in Wilmington. Emily P. Bissell, a Delaware author, designed the seals, and organizers of a local tuberculosis fund drive put them on sale at the Wilmington Post Office in December 1907. The idea for Christmas seals came from a similar fund-raising campaign first used in Denmark.

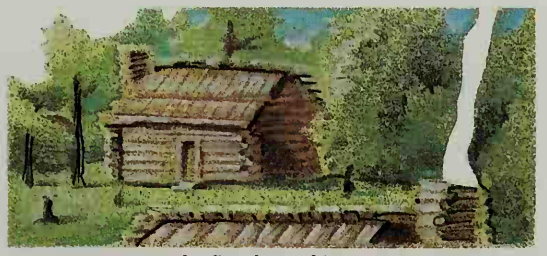
Christmas seals

The first beauty contest in the United States was held at Rehoboth Beach in 1880. Contestants competed for the title of "Miss United States." The famous inventor Thomas Edison was one of the three judges. The contest became the forerunner of today's Miss America pageant.

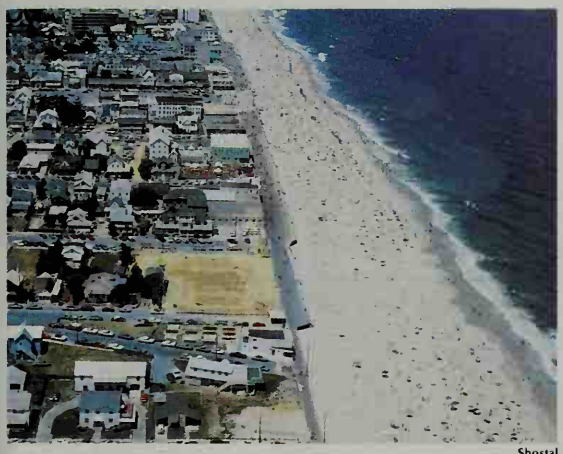
Delaware's border with Maryland runs through two towns, both of which were named by combining the names of the two states. One of the towns is named *Marydel,* and the name of the other town is *Delmar.*

Delaware's northern boundary with Pennsylvania is formed by the arc of a perfect circle. Delaware is the only state to have such a boundary. The circle is centered at the dome of the Court House in the town of New Castle.

Log cabins were first introduced to North America about 1638 by Swedes and Finns who settled near the mouth of the Delaware River. Log construction was already an established practice in Scandinavia and in other parts of Europe.



The first log cabins



Shostal

Rehoboth Beach, on Delaware's southeastern coast, attracts many summertime visitors. Vacationers enjoy the Atlantic Ocean breezes that sweep over the long stretches of beach.

Du Pont & Company

Delaware's chemical industry, centered in the Wilmington area, includes major chemical firms. This researcher works at Du Pont, one of the world's largest chemical manufacturers.

Floyd Dean, Inc.

Wilmington, in the far northeastern corner of Delaware, is the state's largest city. It is also the leading manufacturing center in Delaware. Wilmington's history dates back to the 1630's.

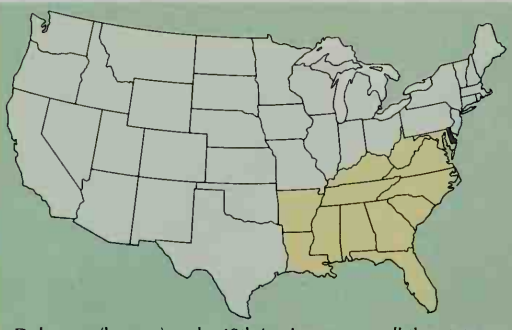
Delaware in brief

Symbols of Delaware

The state flag first appeared in its present form in 1913. It bears a shield with a sheaf of wheat, an ear of corn, and an ox, all of which symbolize agriculture. Above the shield is a sailing ship. A soldier and a farmer support the shield. "December 7, 1787" is the date Delaware became the first state. The state seal was adopted in 1777 and has the same design as the flag. The dates 1793, 1847, and 1911 are years when changes were made.

State flag

State seal



Delaware (brown) ranks 49th in size among all the states, and is the smallest of the Southern States (yellow).

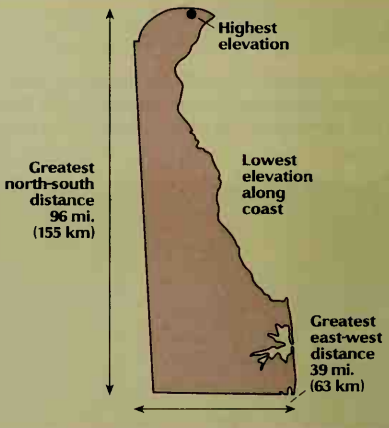
General information

Statehood: Dec. 7, 1787, the first state.
State abbreviations: Del. (traditional); DE (postal).
State motto: *Liberty and Independence.*
State song: "Our Delaware" Words by George B. Hynson; music by William M.S. Brown.

The State Capitol is in Dover, the capital of Delaware since 1777. New Castle had been the capital since 1704.

Land and climate

Area: 2,026 sq. mi. (5,246 km^2), including 71 sq. mi. (184 km^2) of inland water but excluding 371 sq. mi. (960 km2) of coastal water.
Coastline: 28 mi. (45 km).
Elevation: *Highest*—442 ft. (135 m) above sea level on Ebright Road in New Castle County. *Lowest*—sea level along the coast.
Record high temperature: 110 °F (43 °C) at Millsboro on July 21, 1930.
Record low temperature: −17 °F (−27 °C) at Millsboro on Jan. 17, 1893.
Average July temperature: 76 °F (24 °C).
Average January temperature: 35 °F (2 °C).
Average yearly precipitation: 45 in. (114 cm).



Important dates

1638 — Swedish colonists founded Fort Christina, Delaware's first permanent settlement.

1664 — The English seized territory on the Delaware River.

1682 — William Penn took over the Delaware counties.

1787 — Delaware became the first state of the Union.

State bird
Blue hen chicken

State flower
Peach blossom

State tree
American holly

People

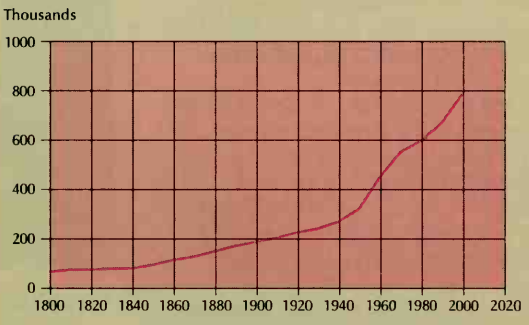
Population: 783,600 (2000 census)
Rank among the states: 45th
Density: 387 per mi² (149 per km²), U.S. average 78 per mi² (30 per km²)
Distribution*: 73 percent urban, 27 percent rural

Largest cities in Delaware

Wilmington	72,664
Dover	32,135
Newark	28,547
Pike Creek†	19,751
Bear†	17,593
Brookside†	14,806

†Unincorporated place.
Source: 2000 census, except for *, where figures are for 1990.

Population trend



Source: U.S. Census Bureau.

Year	Population
2000	783,600
1990	668,696
1980	594,338
1970	548,104
1960	446,292
1950	318,085
1940	266,505
1930	238,380
1920	223,003
1910	202,322
1900	184,735
1890	168,493
1880	146,608
1870	125,015
1860	112,216
1850	91,532
1840	78,085
1830	76,748
1820	72,749
1810	72,674
1800	64,273
1790	59,096

Economy

Chief products

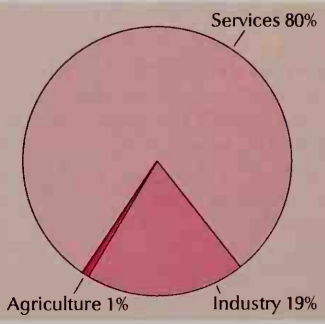
Agriculture: broilers.

Manufacturing: chemicals, paper products, food products, transportation equipment.

Gross state product

Value of goods and services produced in 1998: $33,734,000,000. *Services* include community, business, and personal services; finance; government; trade; and transportation, communication, and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, fishing, and forestry.

Source: U.S. Bureau of Economic Analysis.



Government

State government

Governor: 4-year term
State senators: 21; 4-year terms
State representatives: 41; 2-year terms
Counties: 3

Federal government

United States senators: 2
United States representatives: 1
Electoral votes: 3

Sources of information

For information about tourism, write to: Delaware Tourism Office, 99 Kings Highway, Dover, DE 19901.The Web site at www.visitdelaware.net also provides information.

For information on the economy, write to: Delaware Economic Development Office, 99 Kings Highway, Dover, DE 19901.

The state's official Web site at www.state.de.us also provides a gateway to much information on Delaware's economy, government, and history.

1861-1865 — Delaware fought for the North during the Civil War.

1917 — Delaware established a state highway department.

1957 — The state began providing funds for needy students to attend the University of Delaware.

1971 — The Delaware Coastal Zone Act prohibited construction of industrial plants in coastal areas.

1987 — Delaware celebrated the bicentennial of its statehood.

Population. The 2000 United States census reported that Delaware had 783,600 people. The state's population had increased nearly 18 percent over the 1990 census figure, 666,168. According to the 2000 census, Delaware ranks 45th in population among the 50 states.

About four-fifths of Delaware's people live in metropolitan areas. About two-thirds of the people live in the Wilmington-Newark metropolitan area, which extends into Maryland. Dover is Delaware's only other metropolitan area (see **Metropolitan area**). For the populations of these two areas, see the *Index* to the political map of Delaware with this article.

Wilmington is Delaware's largest city. Dover and Newark are the state's only other cities with more than 28,000 people. Dover is the state capital. Delaware's largest population groups include people of Irish, German, and English descent. About 19 percent of the state's people are African Americans.

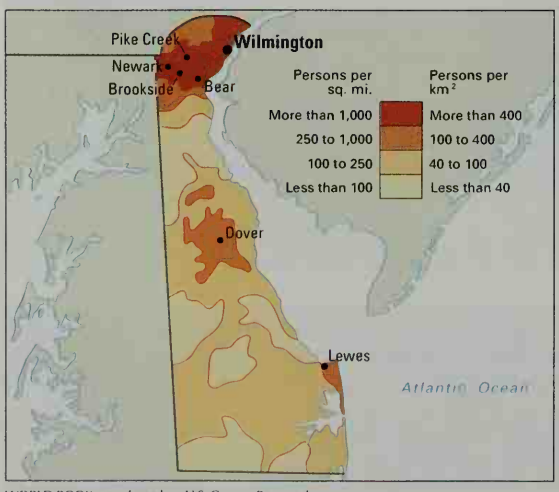
Schools. The Dutch and Swedish colonists who settled the Delaware region in the 1600's valued education. Most of their early schools were run by churches. The English gained control of the region in the 1660's and built schools of their own. But many wealthy English sent their children to schools outside the colony. Poorer children were taught in church schools or by their families, friends, or traveling teachers.

Public education began in the Delaware region after the Revolutionary War in America (1775-1783). The state legislature established a public school fund in 1792 and a system of public education in 1829. But education remained under local control until the 1920's.

Today the seven-member State Board of Education makes policies for the public school system. The governor appoints members to the board, subject to state Senate approval. The board's president has no definite term. The other members serve six-year terms. The Department of Education, headed by the secretary of education, supervises the public school system. The governor appoints the secretary. Children in Delaware must attend school from age 5 through 15. For the number of students and teachers in Delaware, see **Education** (table).

Population density

About two-thirds of Delaware's people live in the Wilmington-Newark metropolitan area, in the far northern part of the state. The Dover and Lewes areas are also heavily populated.



WORLD BOOK map; based on U.S. Census Bureau data.

Universities and colleges

This table lists the universities and colleges in Delaware that grant bachelor's or advanced degrees and are accredited by the Middle States Association of Colleges and Schools.

Name	Mailing address
Delaware, University of	Newark
Delaware State University	Dover
Goldey-Beacom College	Wilmington
Wesley College	Dover
Wilmington College	New Castle

University of Delaware

The Mall at the University of Delaware in Newark

Libraries. The first library in the region was established in Wilmington in 1754, when Delaware was still a British colony. In 1788, after Delaware became a state, the Library Company of Wilmington was incorporated. It still exists as the Wilmington Institution Public Library.

Today public libraries, school libraries, and special libraries exist throughout the state. The DelAware digital library network connects all public and academic library computer systems. The University of Delaware Library houses the highly regarded Unidel History of Chemistry and History of Horticulture collections. The Historical Society of Delaware in Wilmington has an excellent collection of materials on Delaware history.

Museums. The Henry Francis du Pont Winterthur Museum, near Wilmington, has an excellent collection of American decorative arts from the period 1640 to 1840. The Hagley Museum and Eleutherian Mills, also near Wilmington, features industrial life of the 1800's. The Delaware State Museum in Dover is housed in three buildings. Its exhibits illustrate the state's history and culture. Also in Dover, the State Archives features historical documents, including the original royal charter for the land that became Delaware.

The Delaware Art Museum in Wilmington specializes in English paintings of the 1800's. The Corbit-Sharp House and the Wilson-Warner House in Odessa display American antiques. The Old Dutch House, built in New Castle in the 1600's, offers a glimpse into the lives of early Dutch colonists. Other important museums include the Delaware Agricultural Museum in Dover and the Rockwood Museum and Delaware Museum of Natural History, both in Wilmington.

Delaware political map
Urban area
Forest or other conservation area
Military or other federal area
State boundary
County boundary
KENT County name
State capital
County seat
City or town
Point of interest
Major airport
Waterway
Railroad
Highways:
Expressway
Other road
Interstate
U.S.
Other
Transverse Mercator projection
WORLD BOOK map
PENNSYLVANIA
NEW JERSEY
MARYLAND
North Atlantic Ocean
Delaware Bay
Delaware River
Intracoastal Waterway
Chesapeake and Delaware Canal
NEW CASTLE
KENT
SUSSEX
Wilmington
Dover
Georgetown
Newark
New Castle
Kennett Square
Oxford
Chester
Marcus Hook
Talleyville
Claymont
Elsmere
Penns Grove
Pennsville
Salem
Stanton
Newport
Wilmington Manor
Elkton
Delaware City
Middletown
Smyrna
Clayton
Camden
Milford
Harrington
Chestertown
Millville
Wildwood
Cape May
Denton
Seaford
Bridgeville
Laurel
Milton
Lewes
Rehoboth Beach
Millsboro
Selbyville
Cambridge
Odessa
Delmar
Fenwick Island
Bethany Beach
Dewey Beach
JOHN F. KENNEDY MEMORIAL HIGHWAY
NEW JERSEY TURNPIKE
GARDEN STATE PARKWAY
BOMBAY HOOK NATIONAL WILDLIFE REFUGE
PRIME HOOK NATIONAL WILDLIFE REFUGE
DOVER AIR FORCE BASE
CAPE HENLOPEN
NAVAL MILITARY RESERVATION
FORT MILES MILITARY RESERVATION
GREAT CYPRESS SWAMP
WINTERTHUR MUSEUM
OLD SWEDES CHURCH
OLD COURT HOUSE
BARRATT'S CHAPEL
ZWAANENDAEL MUSEUM
DE VRIES MONUMENT
INDIAN MISSION CHURCH
PEA PATCH ISLAND
REEDY ISLAND
BOMBAY HOOK POINT
LITTLE BOMBAY HOOK
DEEPWATER POINT
EGG ISLAND POINT
CAPE MAY
North
39° 30'
38° 30' North Latitude
75° West Longitude
75° 30'
76°
1 2 3 4 5 6 7 8
A B C D E F G H I J K
0 5 10 15 20 25 30 35 40 Miles
0 5 10 15 20 25 30 35 40 50 60 Kilometers

Delaware's many freshwater lakes and ponds, its ocean beaches, and its rivers and streams provide excellent opportunities for fishing, swimming, and boating. A variety of cultural and historical attractions also bring large numbers of visitors to the state every year. One of the most popular annual events in the state is the Delaware State Fair. This event is held in Harrington near the end of July.

Places to visit

Fort Delaware, a pentagon-shaped fort on Pea Patch Island, was used as a prison during the American Civil War (1861-1865). It can be reached by boat from Delaware City.

Great Cypress Swamp, in Trap Pond State Park, near Laurel, has the northernmost natural grove of baldcypresses to be found in the United States.

Hagley Museum and Eleutherian Mills, on Brandywine Creek near Wilmington, features the original powder mills of Éleuthère Irénée du Pont and his residence. The site also has indoor and outdoor exhibits that show development of American industry.

Henry Francis du Pont Winterthur Museum, near Wilmington, contains Henry Francis du Pont's collection of American decorative arts made or used from 1640 to 1860. The Garden, spread over nearly 1,000 acres (400 hectares), has ponds, woods, meadowlands, and both native and nonnative plants.

Houses of worship rank among Delaware's most interesting places to visit. Barratt's Chapel, near Frederica, has been called the Cradle of Methodism in America. The Methodist leaders Francis Asbury and Thomas Coke met in this chapel on Nov. 14, 1784. Their meeting led to the organization of the Methodist Episcopal Church in America. Immanuel Church, an Episcopal church in New Castle, was completed about 1710. In its churchyard are the graves of many people famous in Delaware's early days. Other famous Delaware church buildings, with their completion dates, include Christ Church in Dover (Episcopal, 1734), Christ Episcopal Church on Chipman Pond near Laurel (1771), Old Drawyer's Presbyterian Church near Odessa (1770's), Old Swedes Church in Wilmington (now Episcopal, built as a Swedish Lutheran church in 1698), and Welsh Tract Baptist Church near Newark (1746).

John Dickinson Mansion, near Dover, was the boyhood home of the famous American patriot. The house was built in 1740.

Lewes, on Delaware's southern coast, is the state's oldest settlement. This historic seaport is the site of many picturesque buildings and homes. Also in Lewes, the Zwaanendael Museum is modeled after a wing of the town hall in Hoorn, the Netherlands. Exhibits include historic documents, Indian relics, and mementos of seafaring days in southern Delaware.

New Castle has many historic buildings. The Amstel House, home of the New Castle Historical Society, features exhibits of colonial arts and handicrafts. It was built about 1730. The Court House, which was built in 1732, served as Delaware's colonial capitol and first statehouse. The George Read II House and Garden, completed in 1804, is an elegant example of the Georgian style of architecture.

State House, in Dover, was Delaware's state capitol until 1933. It was built in 1792 and features a restored courtroom and legislative chambers.

State parks. Delaware has 13 state parks and many wildlife areas. For information on Delaware's state parks, write to Delaware State Parks, 89 Kings Highway, P.O. Box 1401, Dover, DE 19903. For information on boating and fishing areas, write to the Delaware Division of Fish and Wildlife, 89 Kings Highway, P.O. Box 1401, Dover, DE 19903.

Delaware map index

Metropolitan areas

Dover 126,697
Wilmington-Newark 586,216
(500,265 in Del.; 85,951 in Md.)

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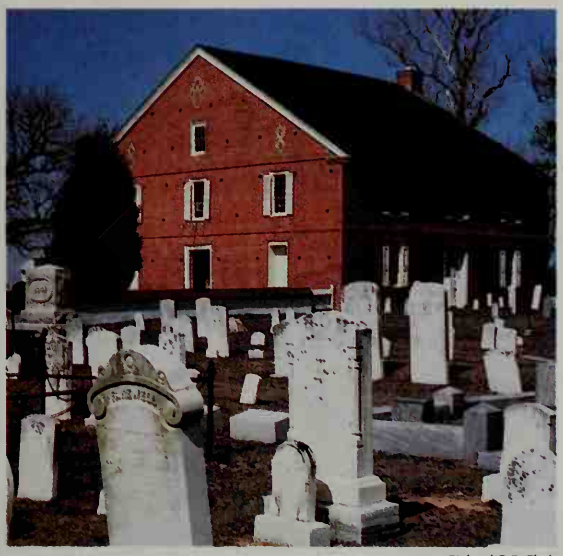
*Does not appear on map; key shows general location.
†Census designated place—unincorporated, but considered a significant settled community by the U.S. Census Bureau.
°County seat.
Places without population figures are unincorporated areas.
Source: 2000 census.

Bob Glander, Shostal

Fort Delaware on Pea Patch Island



Richard C. B. Clark

Barratt's Chapel near Frederica

The Henry Francis du Pont Winterthur Museum

Winterthur Museum

Delaware Tourism Office

Maypole dance at Old Dover Day celebration

Annual events

January-April

Delaware Kite Festival at Cape Henlopen State Park in Lewes (Good Friday); Boardwalk Fashion Promenade at Rehoboth Beach (Easter Sunday); Irish Festival at Hagley Museum near Wilmington (last Saturday in April).

May-August

Old Dover Day (first Saturday in May); Wilmington Garden Day in Wilmington (first Saturday in May); Winterthur Point to Point Horse Race (first Sunday in May); McDonald's LPGA Golf Championship in Wilmington (Spring); NASCAR race in Dover (June); Rockwood's Victorian Ice Cream Festival, Wilmington (July); Delaware State Fair in Harrington (July); Bethany Beach Boardwalk Arts Festival (August).

September-December

Nanticoke Indian Pow-Wow near Oak Orchard (second week in September); Brandywine Arts Festival in Wilmington (second Saturday in September); NASCAR race in Dover (September); Fall Harvest Festival at the Delaware Agricultural Museum in Dover (late October); Christmas and Candlelight tours at nine museums in the Brandywine Valley (December).

Delaware Division of Parks and Recreation

A cypress swamp covers part of southern Delaware. Baldcypress trees and red cedars thrive throughout the region.

WORLD BOOK map

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Bombay Hook Pt.	B	2
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Christina R.	A	1
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Delaware R.	B	2
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Smyrna R.	B	1
White Clay Creek	A	1

Land regions. Delaware has two main land regions. These regions are (1) the Atlantic Coastal Plain and (2) the Piedmont.

The Atlantic Coastal Plain stretches along the east coast of the United States from New Jersey to southern Florida. The coastal plain covers all of Delaware but the northern tip. This region is a low, flat plain that seldom rises over 80 feet (24 meters) above sea level. Some sections of the coastal plain have good farmland. A 30,000-acre (12,000-hectare) swamp lies along Delaware's southern boundary.

The Piedmont extends from New Jersey to Alabama. This region crosses the northern edge of Delaware and is about 10 miles (16 kilometers) wide at its widest point in the state. Rolling hills and fertile valleys cover the Piedmont. The highest point in Delaware, 442 feet (135 meters), is in this region near the northern border of the state.

Coastline of Delaware is 28 miles (45 kilometers) long from Maryland to the mouth of Delaware Bay. If bays, creeks, rivers, and sounds are included, the coastline measures 381 miles (613 kilometers). A long sand reef forms the Atlantic coastline. This dune-covered strip of land is a popular vacation region. An inlet divides the reef near its center, leading into Rehoboth and Indian River bays.

Rivers, bays, and lakes. The broad Delaware River is the state's largest and most important river. It links the Atlantic Ocean with the northern part of Delaware and with parts of New York, Pennsylvania, and New Jersey. The mouth of the Christina River forms the port of Wilmington. Brandywine Creek is the chief tributary of the Christina River. Other streams that flow into the Delaware River include Appoquinimink Creek and the Smyrna River.

Many streams in southeastern Delaware empty into Delaware Bay and the Atlantic Ocean. The most important ones include the Broadkill, Indian, Mispillion, Murderkill, and St. Jones rivers. Most of Delaware's streams flow eastward from a long, low ridge near the western boundary. But most of the rivers in southwestern Delaware flow southward and westward across Maryland and into Chesapeake Bay. The Nanticoke is the most important of these rivers.

Ocean ships sail across Delaware Bay to reach the Delaware River. Rehoboth and Indian River bays lie within the great sand reef in southeastern Delaware. Many of the state's more than 50 small lakes and ponds have good beaches and provide excellent freshwater fishing.

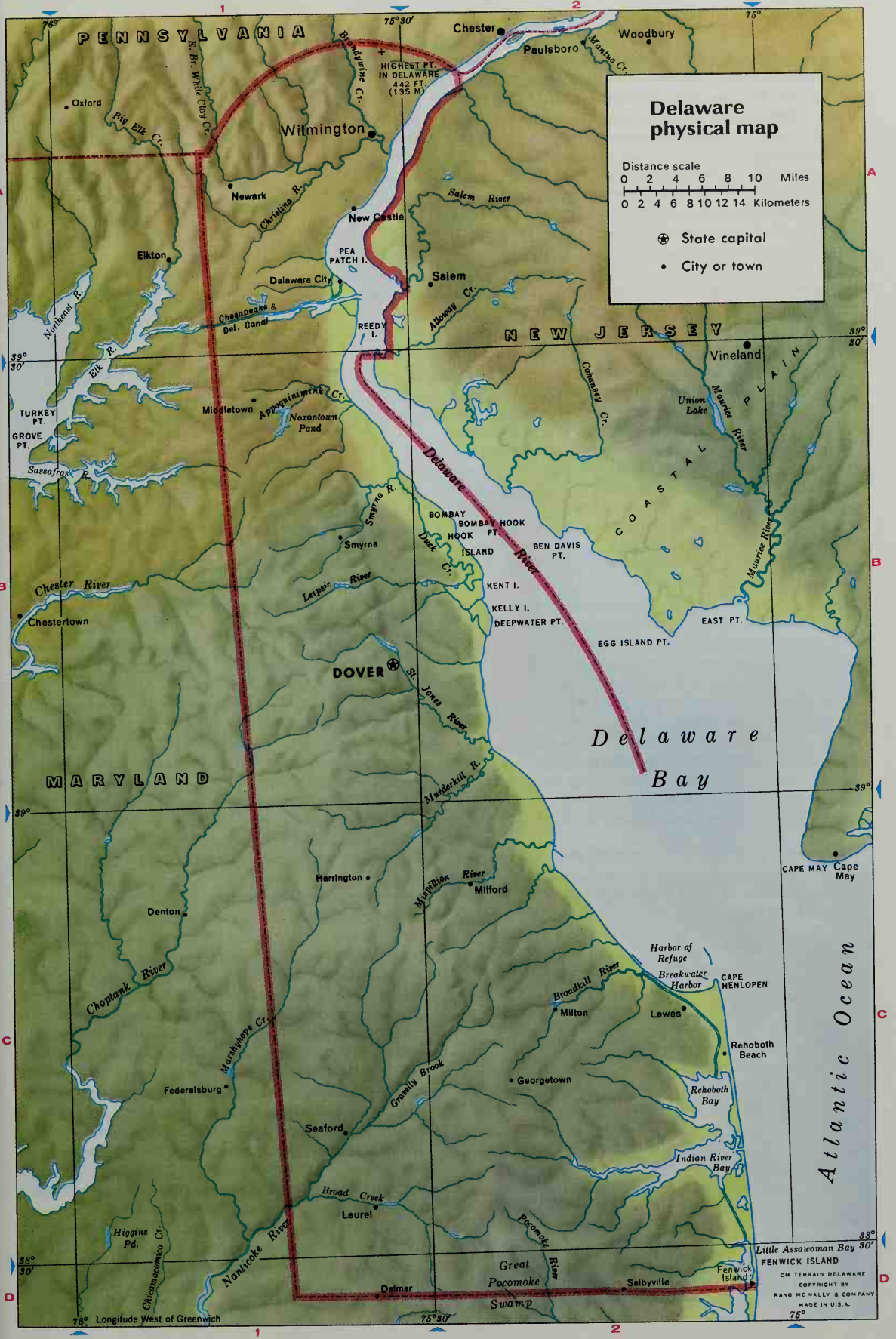
Plant and animal life. Forests cover about a third of Delaware. The state's most common trees include beech, black tupelo, hickory, holly, loblolly pine, oak, shortleaf pine, and sweet gum. Such smaller trees as magnolia, sassafras, wild cherry, and willow are also common in the state. Baldcypress and redcedar trees thrive in the southern swamps.

Many kinds of wild flowers grow in the state. Water lilies and floating hearts dot the ponds and lakes. Pink and white hibiscus flourish in the sea marshes. Magnolias and pink lady's-slippers bloom in the swamps. In some places, blueberries and cranberries form almost impassable thickets.

Average monthly weather

Wilmington

	Temperatures F. High	Low	Temperatures °C High	Low	Days of rain or snow
Jan.	42	25	6	−4	13
Feb.	43	25	6	−4	10
Mar.	53	32	12	0	13
Apr.	63	40	17	4	12
May	75	51	24	11	13
June	83	60	28	16	10
July	87	65	31	18	9
Aug.	85	63	29	17	9
Sept.	79	57	26	14	9
Oct.	67	45	19	7	8
Nov.	55	36	13	2	10
Dec.	44	26	7	−3	11



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Deer, mink, otter, rabbits, and red and gray foxes live in Delaware's fields and forests. Muskrats are found in the marshes and swamps. Common birds of Delaware include blue herons, cardinals, ducks, hawks, orioles, ruby-throated hummingbirds, sandpipers, snowy egrets, and wrens.

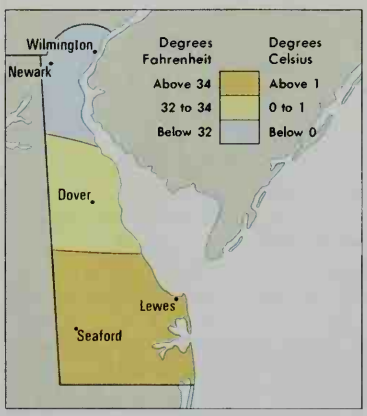
Fishing enthusiasts find bass, carp, catfish, eels, trout, and white perch in the state's lakes, ponds, and streams. Coastal waters have clams, crabs, menhaden, oysters, sea trout, shad, and striped bass. Some diamondback terrapins live along the coast. Snapping turtles are found in the swamps.

Climate. Delaware has a humid climate with hot summers and generally mild winters. On hot summer days, Atlantic breezes cool the beaches. Mountains in Pennsylvania protect Delaware from the northwest winds of winter. Temperatures away from the coast vary across the state by about 4 °F (2 °C) in summer and 2 °F (1 °C) in winter. Temperatures in the state average 76 °F (24 °C) in July and 35 °F (2 °C) in January. Millsboro had both the highest and lowest temperatures ever recorded in Delaware. On July 21, 1930, the temperature there reached 110 °F (43 °C). On Jan. 17, 1893, the temperature there fell to −17 °F (−27 °C).

The state averages about 45 inches (114 centimeters) of *precipitation* (rain, melted snow, and other forms of moisture) a year. Snowfall varies from an annual average of about 18 inches (46 centimeters) in the north to 14 inches (36 centimeters) in the south. The coast receives about 12 inches (30 centimeters) of snow a year.

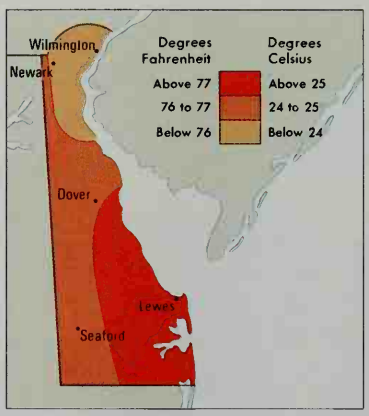
Average January temperatures

Delaware has generally mild winters because mountains in Pennsylvania protect the state from wintry northwest winds.



Average July temperatures

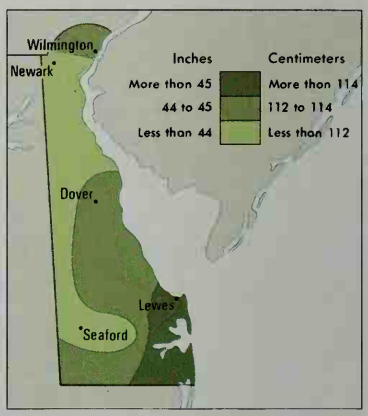
The state has hot, humid summers. The southeastern portion of Delaware has the highest temperature.



Average yearly precipitation

Precipitation is distributed fairly evenly throughout the state. The north and southeast receive the most precipitation.

WORLD BOOK maps



Economy

Delaware's economy relies more on financial services than any other state. Service industries, led by the finance, insurance, and real estate sector, rank as Delaware's most important economic activity. The production of chemicals is the most important manufacturing activity.

A state law permits businesses to incorporate in Delaware even if they have nothing but a mailing address in the state. Companies find it easy and inexpensive to incorporate in Delaware. For this reason, many of the largest companies in the United States incorporate in Delaware, even though they do almost all their business outside the state.

Natural resources of Delaware include fertile soil and mineral deposits.

Soil. Most of the state is covered by soils that are generally fertile but somewhat sandy. Some of the rocky hills of the Piedmont in northern Delaware are covered by patches of gravel and coarse, red sand and silt. A mixture of clay and loam soils covers the region just south of the Piedmont.

Minerals. Delaware has deposits of clays, sand and gravel, and stone. Brandywine blue granite, a building material used for decorative purposes, is also found in the state.

Service industries, taken together, account for the largest portion of Delaware's *gross state product*—the total value of all goods and services produced in a state in a year. This group employs over three-fourths of the state's workers. The state's service industries are concentrated in the Wilmington metropolitan area.

Finance, insurance, and real estate contribute more to the gross state product than any other industry in Delaware. Banking in the state has grown rapidly since 1980. During the early 1980's, the Delaware government reduced taxes and fees on banking companies doing business in the state. As a result, many large banks moved some of their operations to Delaware. The Wilmington area is an important national financial center. Several large insurance companies and investment firms are also based in the Wilmington area. The growth of banks and other businesses in northern Delaware has created demand for new office space and homes. This demand has benefited the state's real estate companies.

Community, business, and personal services rank second among Delaware's service industries in terms of the

Production and workers by economic activities

Economic activities	Percent of GSP* produced	Employed workers	
		Number of people	Percent of total
Finance, insurance, & real estate	41	64,400	13
Manufacturing	16	60,300	13
Community, business, & personal services	15	139,900	29
Wholesale & retail trade	10	98,300	20
Government	9	63,600	13
Transportation, communication, & utilities	5	18,200	4
Construction	3	29,400	6
Agriculture	1	9,000	2
Mining	†	200	†
Total	100	483,300	100

*GSP = gross state product, the total value of goods and services produced in a year.
†Less than one-half of 1 percent.
Figures are for 1998.
Sources: *World Book* estimates based on data from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

gross state product. This industry consists of a wide variety of economic activities, including private health care, law firms, hotels, and car rental agencies. Wilmington is the leading health care center. Resort hotels dot the southern Delaware coastline.

Wholesale and retail trade form the third-ranking service industry in Delaware. Distributors of automobiles, food products, and commercial equipment and supplies play a leading role in the state's wholesale trade. Such retail establishments as discount stores, grocery stores, and restaurants employ many of the state's workers.

Government ranks fourth among service industries in Delaware. Government services include the operation of public schools and hospitals, and military bases. The public school system is one of the state's major employers. The federal government operates Dover Air Force Base. State government offices are located primarily in Dover and Wilmington.

Transportation, communication, and utilities rank fifth among Delaware service industries in terms of the gross state product. Railroad and trucking companies transport the state's manufactured and imported goods to major East Coast markets. Conectiv Power Deliveries is Delaware's largest utility. More information about transportation and communication can be found later in this section.

Manufacturing. Goods made in Delaware have a *value added by manufacture* of about $5 billion annually. Value added by manufacture represents the increase in value of raw materials after they become finished goods.

Chemicals are Delaware's chief manufactured product in terms of value added by manufacture. Wilmington is sometimes called the *Chemical Capital of the World.* It is the headquarters of E. I. du Pont de Nemours & Company, Hercules Inc., and ICI (America) Inc. The DuPont Company has several plants in Delaware. Its research center, near Wilmington, is one of the largest in the world. Other important chemical companies also have factories, offices, and research laboratories in Delaware. Chemical factories in Delaware produce drugs, industrial chemicals, and plastics and other synthetic materials. Although Delaware does not rank among the leading chemical manufacturing states, it is among the leaders in chemical management and research.

Paper products rank second among the state's manufactures. Factories that make paper products are located in the Wilmington area.

Food processing ranks third among Delaware's manufacturing activities. A large plant in Dover makes gelatin, pudding, and other prepared desserts. Sussex County has several large canneries and poultry processing plants. The state's other processed foods include baked goods, fish products, and soft drinks.

Automobile production is also important to the state's economy. Two automobile manufacturing plants, located in Newark and Newport, provide a major source of employment in the state. Delaware's other manufactures include medical equipment, plastics products, printed materials, and scientific instruments.

Agriculture. Farmland covers about half of Delaware's land area. The state has about 2,500 farms.

Livestock and related products account for about 75 percent of Delaware's farm income. *Broilers* (chickens from 5 to 12 weeks old) are the state's most valuable farm product by far. Delaware ranks as an important broiler-producing state. Most of the broilers come from Sussex County. Farms in Kent and New Castle counties produce the largest amounts of milk in the state. Farms in southern Delaware raise most of the state's hogs.

Crops provide about 20 percent of Delaware's farm income. Soybeans are the state's leading crop, raised on about 40 percent of the cultivated land. Corn, the second most valuable crop, is grown throughout the state. Delaware's farmers also grow barley and wheat. Potatoes and peas are the largest vegetable crops in Delaware. Apples are the state's leading fruit crop.

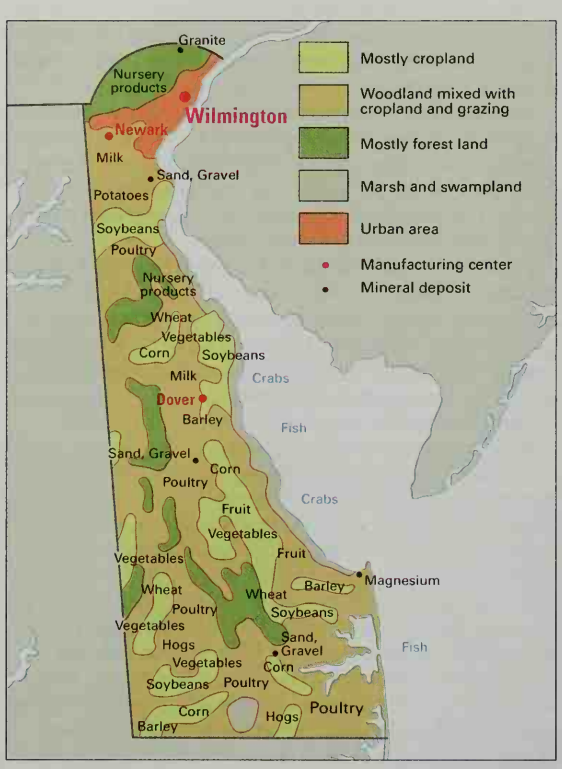
Greenhouse and nursery products are also an important source of agricultural income. These products include flowers, ornamental shrubs, and young plants.

Delaware Department of Agriculture

Workers in a poultry processing plant in Millsboro prepare broiler chickens for shipment to food stores. Food processing is an important manufacturing activity in Delaware.

Economy of Delaware

This map shows the economic uses of land in Delaware and where the leading farm, mineral, and forest products are produced. Major manufacturing centers are shown in red.



WORLD BOOK map

Mining. Delaware ranks last among the states in annual value of mineral production. Magnesium is the leading mineral product. A plant near Lewes processes seawater to obtain magnesium. Sand and gravel provide nearly all of the remaining mining income. All three of Delaware's counties produce sand and gravel.

Fishing industry in Delaware has an annual fish catch worth about $7 million. Crabs are the most valuable catch. Workers in the industry also bring in quantities of clams, sea bass, sea trout, and shad. Delaware's most valuable freshwater fish include eels and carp.

Electric power. Coal-burning plants generate about 50 percent of Delaware's electric power. Petroleum-burning plants and plants that burn natural gas each supply about 20 percent of the state's power.

Transportation. The Delaware River and its tributaries formed the first transportation system in the Delaware region. The state's first railroad, the New Castle and Frenchtown Railroad, was completed in 1831. Delaware's modern highway system began in 1911, when Thomas Coleman du Pont built a paved highway between Wilmington and the Maryland border.

Wilmington is Delaware's chief port for foreign shipping. The Chesapeake and Delaware Canal crosses northern Delaware. Ships traveling between Baltimore, Maryland, and Philadelphia, Pennsylvania, can save about 285 miles (460 kilometers) by using the Chesapeake and Delaware Canal. The Lewes and Rehoboth Canal connects Lewes with Rehoboth Bay.

Delaware has about 6,000 miles (9,650 kilometers) of roads and highways. The Delaware Memorial Bridge, which crosses the Delaware River near New Castle, connects northern Delaware with New Jersey. The Delaware Turnpike John F. Kennedy Memorial Highway links northern Delaware and northeastern Maryland. The turnpike forms part of a major nonstop highway between Boston and Washington, D.C. The Cape May-Lewes Ferry crosses Delaware Bay and connects southern Delaware with New Jersey.

Two railroad lines in the state provide freight service. Newark and Wilmington are the only Delaware cities served by passenger trains.

Communication. The *Delaware Gazette* was the first successful newspaper published in the Delaware region. Jacob A. Killen began publishing it in Wilmington in 1785. Delaware's first radio station, WDEL, began broadcasting in Wilmington in 1922. The state's first TV station began operating in Wilmington in 1949. Today, the state has 2 daily newspapers and about 15 weeklies. The dailies are Dover's *Delaware State News* and *The News Journal* of Wilmington. About 15 periodicals are published in the state. Delaware has about 25 radio stations and 5 television stations. Cable television systems and Internet providers serve communities statewide.

Government

Constitution of Delaware dates from 1897. Earlier constitutions were adopted in 1776, 1792, and 1831. An *amendment* (change) to the Constitution may be proposed by the state legislature or by a constitutional convention. Legislative amendments must be approved by two-thirds of the members of both houses of the legislature. They must then be approved in a similar manner after the next legislature is elected. Delaware is the only state in which legislative amendments do not need approval by the voters. Before a constitutional convention can meet, it must be approved by two-thirds of both houses of two successive legislatures. Then it must be approved by a majority of the people who vote on it.

Executive. Delaware's governor serves a four-year term and may be reelected only once. These terms may be served in succession. The lieutenant governor, the attorney general, and the insurance commissioner are each elected to four-year terms. The state treasurer and the auditor of accounts are also elected to four-year terms. The governor appoints a number of major state officials, including the secretary of state, members of an executive department cabinet, judges, and members of the state board of education.

Legislature is also called the General Assembly. It consists of a 21-member Senate and a 41-member House of Representatives. State senators are elected to four-year terms, and representatives to two-year terms. Regular legislative sessions begin on the second Tuesday in January each year. Regular sessions may not extend beyond June 30. The governor or the presiding offi-

cers of both houses may call for special sessions. Special sessions have no time limit.

In 1897, when Delaware's current Constitution was adopted, the state was shifting toward an industrial economy. It tried to protect farmers by giving them greater representation than city areas in the legislature. In 1964, Delaware changed its legislative districts to give better representation to the state's city areas. But in 1967, a federal court ruled that the change did not give enough representation to city areas. Delaware redrew its legislative districts in 1968. The state also redrew the districts in later years, following federal censuses.

Courts. All Delaware judges are appointed by the governor, with the approval of the state Senate. The highest court is the state Supreme Court. It has a chief justice and four associate justices. The governor selects the chief justice.

The Superior Court has 17 judges. It meets in all three counties of the state. Delaware's Court of Chancery has played a major role in developing the state's corporation laws. Other Delaware courts include the Wilmington Municipal Court, family courts and common pleas courts in each county, and justice of the peace courts. Justices of the peace serve four-year terms. All other judges serve 12-year terms.

Local government. Delaware has only three counties—Kent, New Castle, and Sussex. The county of New Castle is governed by a six-member council headed by an elected president. Sussex County has a five-member council, with one councilman serving as president. An elected *levy court* (county commission) governs Kent County. The levy court is made up of seven members. All members of the three county governing bodies serve four-year terms. Other elected county officials in Delaware include a comptroller, sheriff, and recorder of deeds. Delaware is the only state in which counties are divided into *hundreds*. A hundred has no government of its own, but it serves as a basis for property and zoning location.

A state law permits Delaware municipalities of 1,000 or more people to have *home rule* (self-government) to the extent that they may amend their own charters. Most Delaware cities and towns have either a mayor-council or a council-manager form of government.

Revenue. Taxation provides about half of the state government's general fund revenue. Most of the rest is federally funded. Individual and corporate income taxes and fees for corporation licenses are the main sources of tax income. Other sources of revenue in the state include taxes on insurance premiums, motor fuels, public utilities, and tobacco products. The state has no sales taxes or personal property taxes.

The state governors of Delaware

	Party	Term		Party	Term
John McKinly	None	1777	**William Tharp**	Democratic	1847-1851
Thomas McKean	None	1777	**William H. Ross**	Democratic	1851-1855
George Read	None	1777-1778	**Peter F. Causey**	†American	1855-1859
Caesar Rodney	None	1778-1781	**William Burton**	Democratic	1859-1863
John Dickinson	None	1781-1782	**William Cannon**	Union	1863-1865
John Cook	None	1782-1783	**Gove Saulsbury**	Democratic	1865-1871
Nicholas Van Dyke	None	1783-1786	**James Ponder**	Democratic	1871-1875
Thomas Collins	None	1786-1789	**John P. Cochran**	Democratic	1875-1879
Jehu Davis	None	1789	**John W. Hall**	Democratic	1879-1883
Joshua Clayton	Federalist	1789-1796	**Charles C. Stockley**	Democratic	1883-1887
Gunning Bedford, Sr.	Federalist	1796-1797	**Benjamin T. Biggs**	Democratic	1887-1891
Daniel Rogers	Federalist	1797-1799	**Robert J. Reynolds**	Democratic	1891-1895
Richard Bassett	Federalist	1799-1801	**Joshua H. Marvil**	Republican	1895
James Sykes	Federalist	1801-1802	**William T. Watson**	Democratic	1895-1897
David Hall	*Dem.-Rep.	1802-1805	**Ebe W. Tunnell**	Democratic	1897-1901
Nathaniel Mitchell	Federalist	1805-1808	**John Hunn**	Republican	1901-1905
George Truitt	Federalist	1808-1811	**Preston Lea**	Republican	1905-1909
Joseph Haslet	*Dem.-Rep.	1811-1814	**Simeon S. Pennewill**	Republican	1909-1913
Daniel Rodney	Federalist	1814-1817	**Charles R. Miller**	Republican	1913-1917
John Clark	Federalist	1817-1820	**John G. Townsend, Jr.**	Republican	1917-1921
Jacob Stout	Federalist	1820-1821	**William D. Denney**	Republican	1921-1925
John Collins	*Dem.-Rep.	1821-1822	**Robert P. Robinson**	Republican	1925-1929
Caleb Rodney	Federalist	1822-1823	**C. Douglass Buck**	Republican	1929-1937
Joseph Haslet	*Dem.-Rep.	1823	**Richard C. McMullen**	Democratic	1937-1941
Charles Thomas	*Dem.-Rep.	1823-1824	**Walter W. Bacon**	Republican	1941-1949
Samuel Paynter	Federalist	1824-1827	**Elbert N. Carvel**	Democratic	1949-1953
Charles Polk	Federalist	1827-1830	**J. Caleb Boggs**	Republican	1953-1960
David Hazzard	American Republican	1830-1833	**David P. Buckson**	Republican	1960-1961
			Elbert N. Carvel	Democratic	1961-1965
Caleb P. Bennett	Democratic	1833-1836	**Charles L. Terry, Jr.**	Democratic	1965-1969
Charles Polk	Whig	1836-1837	**Russell W. Peterson**	Republican	1969-1973
Cornelius P. Comegys	Whig	1837-1841	**Sherman W. Tribbitt**	Democratic	1973-1977
William B. Cooper	Whig	1841-1845	**Pierre S. du Pont IV**	Republican	1977-1985
Thomas Stockton	Whig	1845-1846	**Michael N. Castle**	Republican	1985-1993
Joseph Maull	Whig	1846	**Tom Carper**	Democratic	1993-2001
William Temple	Whig	1846-1847	**Ruth Ann Minner**	Democratic	2001-

*Democratic-Republican

†Also called the Know-Nothing Party

Politics. From 1900 through 1932, Delaware's electoral votes were cast for Republican presidential candidates every time except in 1912. Since 1936, Republicans and Democrats have won the votes about the same number of times. For Delaware's electoral votes in presidential elections, see **Electoral College** (table).

Republicans held the state's governorship during most of the first half of the 1900's. But the office has passed back and forth between Republicans and Democrats during the second half.

History

Indian days. Two tribes of Algonquian Indians lived in the Delaware region when white explorers first arrived. The Lenape tribe, now known as the Delaware Indians, lived along the banks of the Delaware River. The Nanticoke lived along the Nanticoke River in the southwestern part of the region. By the mid-1700's, white settlers had forced most of the Indians out of the region.

Exploration and early settlement. Henry Hudson, an English explorer, was probably the first white person to visit the Delaware region. He sailed into present-day Delaware Bay in 1609. Hudson was trying to find a trade route to the Far East for the Dutch East India Company. Seeing that the bay led to a river, Hudson left the region and sailed northward. In 1610, Captain Samuel Argall of the Virginia colony sailed into the bay, seeking shelter from a storm. Argall named the bay De La Warr Bay, for Lord De La Warr, the governor of Virginia. The Dutch attempted to establish the first settlement in the region at Zwaanendael (present-day Lewes) in 1631. But trouble developed between the Dutch settlers and the Indians. Within a year, the Indians killed the settlers and burned their fort.

Swedish settlers came to the Delaware region in 1638. They founded the colony of New Sweden, the first permanent colony in the region. Their first settlement was Fort Christina, located at present-day Wilmington. New settlers came to New Sweden from Sweden and Finland, and expanded the colony northward.

The Landing of the Swedes (early 1900's), an oil painting on canvas by Stanley M. Arthurs; Permanent Collection of the University of Delaware

Swedish settlers arrived in the Delaware area in 1638. They founded the colony of New Sweden and built Fort Christina at what is now Wilmington as their first permanent settlement.

The Dutch government believed that New Sweden was in Dutch territory. In 1651, Peter Stuyvesant, governor of the Dutch colony of New Netherland, established Fort Casimir at present-day New Castle. The Swedish colonists captured Fort Casimir in 1654. But the following year, the Dutch captured all New Sweden and made it part of New Netherland.

English rule. In 1664, England captured all New Netherland, including the Delaware region. The English ruled the Delaware settlements as part of the colony of New York. The Dutch recaptured the region in 1673 but returned it peacefully to the English the following year.

In 1681, the English king granted William Penn a charter giving him the right to establish the colony of Pennsylvania. Penn wanted to provide his colony with access to the Atlantic Ocean. In 1682, the Duke of York gave the Delaware region to Penn as a territory of his colony. That same year, Penn established representative government for both the colony and the territory. Both the Pennsylvania and Delaware regions had the same number of delegates in Pennsylvania's legislature.

The Delaware region became known as the Three Lower Counties because it was down the Delaware River from Pennsylvania. Pennsylvania continued to grow in the late 1600's and added new counties. Colonists in the Three Lower Counties began to fear that they would soon have a minority voice in the government. In 1701, delegates from the Three Lower Counties refused to meet with those from Pennsylvania. They asked Penn to give them a separate legislature, and Penn consented. The first separate legislature of the Three Lower Counties met in 1704. Pennsylvania governors continued to govern the Three Lower Counties until the Revolutionary War.

The Revolutionary War. Britain imposed unpopular taxes on the American Colonies during the 1760's. Colonists in the Three Lower Counties resented these taxes. They sent delegates to Philadelphia to attend the First Continental Congress in 1774.

The Revolutionary War began in 1775. On July 2, 1776, the Three Lower Counties joined other American Colonies in voting for independence at the Second Continental Congress. Later that year, the region became the Delaware State, and its people adopted their first constitution. In 1777, John McKinly won election as Delaware's first president (governor). New Castle served as the capital.

Delaware soldiers fought throughout the Revolutionary War. Only one small battle took place on Delaware soil. In August 1777, British troops landed in Maryland and marched across Delaware toward Philadelphia. American troops met the British at Coochs Bridge near

Historic Delaware

Henry Hudson, an English explorer, visited Delaware Bay in 1609. He was searching for a trade route to the Far East for the Dutch East India Company and sailed into the bay in hopes of finding a clear passage.

Peter Stuyvesant, a Dutch colonial governor in North America, established Fort Casimir in 1651 at the site of present-day New Castle.

Nylon was developed by research chemists at the DuPont Company. They combined water, air, and a by-product of coal in a chemical process. DuPont introduced nylon commercially in 1938.

Delaware became the first state on Dec. 7, 1787. On that date, it ratified the U.S. Constitution, the first of the original 13 states to do so.

Éleuthère Irénée du Pont, a French immigrant, established a powder mill on Brandywine Creek, near Wilmington, in 1802. The mill formed the basis for Delaware's chemical industry.

WORLD BOOK illustrations by Kevin Chadwick

Important dates in Delaware

1609 English explorer Henry Hudson, sailing for the Dutch, visited Delaware Bay.
1610 A ship commissioned by Lord De La Warr, governor of Virginia, entered Delaware Bay.
1631 The Dutch founded Zwaanendael at present-day Lewes.
1638 Swedish colonists founded the colony of New Sweden. They established Fort Christina, Delaware's first permanent settlement, at present-day Wilmington.
1655 The Dutch captured New Sweden.
1664 The English seized Dutch territory on the Delaware River.
1682 William Penn took over the Delaware counties.
1704 Delaware's first separate legislature met.
1777 The British invaded Delaware and won a small battle at Coochs Bridge.
1779 Delaware signed the Articles of Confederation.
1787 (Dec. 7) Delaware became the first state of the Union.
1802 Éleuthère Irénée du Pont founded a powder mill on the banks of Brandywine Creek.
1861-1865 Delaware fought on the Union side during the American Civil War.
1897 Delaware adopted its present Constitution.
1951 The Delaware Memorial Bridge opened, connecting Delaware with New Jersey.
1957 The state began providing funds for needy students to attend the University of Delaware.
1963 The Delaware Turnpike John F. Kennedy Memorial Highway was opened, completing a nonstop highway between Boston and Washington, D.C.
1971 The Delaware Coastal Zone Act prohibited construction of industrial plants in coastal areas.
1987 Delaware celebrated the bicentennial of its statehood.

Newark on Sept. 3, 1777. The outnumbered Americans retreated, and the British went on to Pennsylvania. There they defeated General George Washington's forces in the Battle of Brandywine, just north of the Delaware border, on September 11. On September 12, the British occupied Wilmington. Delaware moved its capital from New Castle because of the closeness of British troops. The legislature met at several sites before making Dover the capital. The British stayed for about a month in Wilmington, where they treated their wounded. Then they moved on.

Statehood. On Feb. 22, 1779, Delaware signed the Articles of Confederation (the forerunner to the U.S. Constitution). But leaders from Delaware and other colonies were dissatisfied with the Articles of Confederation. They urged the adoption of a stronger body of rules. John Dickinson and George Read of Delaware helped draft a constitution. On Dec. 7, 1787, Delaware voted unanimously to *ratify* (approve) the United States Constitution. It was the first state to do so. In 1792, Delaware adopted a new state constitution and changed its name from the Delaware State to the State of Delaware.

During and after the Revolutionary War, the Wilmington area became the center of the nation's flour-milling industry. In 1802, Éleuthère Irénée du Pont, a French immigrant, established a powder mill on Brandywine Creek near Wilmington. This mill was the beginning of Delaware's great chemical industry.

During the War of 1812, British ships stopped carrying goods to the United States. As a result, new industries sprang up in Delaware and in other states to provide needed goods. British ships bombarded Lewes in 1813, but they caused little damage.

The Civil War and industrial expansion. Delaware was a slave state, but it also was one of the original 13 states of the Union. Because of Delaware's location between the North and the Deep South, Delawareans had strong ties with both the Union and the Confederate states. The state fought on the Union side during the Civil War (1861-1865). But many Delawareans felt that the Confederate States should have been allowed to *secede* (withdraw) peacefully from the Union.

President Abraham Lincoln issued the Emancipation Proclamation in 1863, freeing the slaves in all areas of the Confederate States still in rebellion. But the Emancipation Proclamation did not affect slave states that had remained loyal to the Union. The few slaves left in Delaware were not freed until 1865. That year, Amendment 13 to the U.S. Constitution abolished all slavery in the United States.

Delaware's farms and industries prospered during and after the Civil War. The growth of railroads in the 1850's helped farmers move their crops to market. As a result, the value of farmland in southern Delaware increased. During the late 1800's, Wilmington grew rapidly as an industrial city. Thousands of people worked in the city's shipyards, iron foundries, machine shops, and manufacturing plants. Delaware's present constitution was adopted in 1897.

The early 1900's brought improvements in education, public welfare, and roadbuilding in Delaware. By 1920, the legislature had established an industrial-accident board, a state board of charities (now the state board of welfare), and a state highway department. The legislature also set up a state income tax, and a pension system to help mothers of needy children. In the 1920's, Pierre S. du Pont gave several million dollars to build new schools and to aid public education in the state. Du Pont also served as state tax commissioner.

The Great Depression of the 1930's put thousands of Delawareans out of work. Richard C. McMullen was elected governor in 1936. He was the state's first Democratic governor since 1901. In 1941, the state legislature changed its Sunday blue laws, placing fewer restrictions on Sunday activities (see **Blue laws**).

The mid-1900's. During World War II (1939-1945), many Delaware factories and mills produced materials for the armed services. The state's economy grew rapidly in the 1950's and 1960's. The Delaware Memorial Bridge across the Delaware River opened in 1951, connecting Delaware with New Jersey. New industries came into Delaware, including such giant corporations as Chrysler, General Foods, and General Motors. Many other companies expanded their facilities, and Du Pont became Delaware's largest employer.

Delaware's population increased about 40 per cent during the 1950's and rose another 20 per cent in the 1960's. This growth took place chiefly in cities and suburbs. However, the state constitution, adopted in 1897, favored representation of rural areas in the state legislature. By the 1960's, a minority of the voters was electing a majority of the legislators. Delaware's legislative districts were redrawn in 1964 and 1968 in an attempt to give the voters equal representation.

Delaware State Archives

Fort Delaware became a prison for captured Confederate soldiers during the Civil War (1861-1865). The pentagon-shaped fort is located on Pea Patch Island in the middle of the Delaware River. The fort was originally built for coastal defense in 1859.

Like many other states, Delaware faced racial problems in the 1950's and 1960's. Black groups challenged the state's system of separate schools for white and black children. In 1954, the Supreme Court of the United States ruled that compulsory segregation in public schools was unconstitutional. By the mid-1960's, all of Delaware's public school districts were integrated. In 1963, the state legislature passed a bill banning segregation in public eating and drinking places. In 1969, the legislature approved a bill ending discrimination in the rental or sale of housing in Delaware.

A new state agency, the Department of Natural Resources and Environmental Control, was set up in 1969 to promote conservation and to control air and water pollution in Delaware. In 1971, the Delaware legislature passed the Coastal Zone Act. This legislation banned construction of industrial plants along the Delaware coastline. The legislature also responded to further pressure from the state's growing urban districts by continuing to redraw Delaware's legislative districts.

Recent developments. In 1980, the state adopted a constitutional limit that restricted government spending to 95 percent of the government's expected revenue. The government's unspent revenue helped improve the state's financial base.

During the same period, the Delaware government reduced taxes and fees on banks in the state. In the 1980's, many banks and other financial institutions began operations in Delaware. The growth of financial activity in the state continued in the 1990's. In addition, tourism increased during the 1980's and 1990's.

Barbara E. Benson and Peter W. Rees

Study aids

Related articles in *World Book* include:

Biographies

Bassett, Richard
Bedford, Gunning, Jr.
Broom, Jacob
Cannon, Annie J.
Clayton, John M.
De La Warr, Lord
Dickinson, John
Du Pont, Éleuthère Irénée
Evans, Oliver
Hudson, Henry
Marquand, John P.
McKean, Thomas
Penn, William
Pyle, Howard
Read, George
Rodney, Caesar
Stuyvesant, Peter

Cities

Dover
Newark
Wilmington

History

Colonial life in America
Delaware Indians
Mason and Dixon's Line
New Netherland
New Sweden
Revolutionary War in America

Physical features

Delaware Bay
Delaware River
Piedmont region

Other related articles

Delaware, University of
DuPont Company
Log cabin

Outline

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- B. Schools
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- D. Museums

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- A. Places to visit
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- A. Constitution
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VI. History

Questions

Why do so many large corporations have their headquarters in Delaware?
What is a *hundred*?
With what other state did Delaware once share its governor and General Assembly? Why?
Why did the Emancipation Proclamation have no effect in Delaware, a slave state?
How does the Delaware Constitution differ from all other state constitutions?
Why is Delaware often called the First State?
What name was given to the Delaware region after it became a territory of Pennsylvania? Why did Delaware receive this name?
When and why was Delaware's capital moved from New Castle to Dover?
How has Delaware tried to promote conservation and to control air and water pollution?
What are Delaware's most important agricultural and manufactured products?

Additional resources

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Delaware, Lord. See De La Warr, Lord.

Delaware, University of, is a coeducational university at Newark, Delaware. It has colleges of arts and science; agricultural sciences; business and economics; education; engineering; human resources; marine studies; nursing; physical education, athletics, and recreation; and urban affairs and public policy. The university grants associate degrees and bachelor's, master's, and doctor's degrees. In cooperation with two museums and a botanical garden, it offers graduate programs in early American decorative arts, industrial history, and ornamental horticulture. The university first opened as an academy in 1743. It became Newark College in 1833, and was renamed Delaware College in 1843. In 1921, it became the University of Delaware.

Critically reviewed by the University of Delaware

Delaware Bay is a large inlet of the Atlantic Ocean. It separates New Jersey and Delaware. The deep channel of the bay connects with the Delaware River, enabling oceangoing vessels to reach the ports of Wilmington, Del., and Philadelphia. Delaware Bay is about 50 miles (80 kilometers) long and about 35 miles (56 kilometers) wide at its widest point. The channel is from 30 to 60 feet (9 to 18 meters) deep through its entire length. At Cape Henlopen, near the bay entrance, a breakwater provides shelter for ships. See also **Delaware** (physical map); **Delaware River.** Peter W. Rees

Delaware Indians is the English name of a tribe that lived in what are now Delaware, New Jersey, New York, and Pennsylvania. These Indians called themselves *Lenape,* which means *genuine people.* Their English name came from the Delaware River, which flowed through their land. The tribe farmed, hunted, and fished. The Delaware were divided into three major groups—the Munsee, the Unalachtigo, and the Unami. Each group spoke a different dialect of a language that belonged to the Algonquian language family.

In 1682, the Delaware signed a treaty of friendship with the English colonial leader William Penn. Despite the treaty, however, Europeans began to take the Indians' land and gradually pushed them westward.

During the 1760's, a religious leader known as the Delaware Prophet preached that Indians should abandon the use of firearms, steel, and other European inventions. He told the Indians they could gain the power to expel the Europeans from their land by returning to traditional tribal ways of life. The Delaware Prophet influenced an Ottawa Indian leader named Pontiac, who tried to unite the Delaware and other Indians in an attempt to drive out the intruders. The British defeated Pontiac in 1763.

In 1818, the Delaware surrendered all their land east of the Mississippi River to the government. Most of the Delaware moved to Missouri and then to Kansas. In the 1860's, they moved to Oklahoma, where about 300 of them now live, many as farmers. Others live in Wisconsin or in Ontario, Canada. Merwyn S. Garbarino

See also **Munsee Indians.**

Delaware River rises in southern New York and flows southward for about 300 miles (480 kilometers) before emptying into Delaware Bay. It passes through the Delaware Water Gap near Stroudsburg, Pennsylvania (see **Delaware Water Gap**). The Delaware forms the boundary between New York and Pennsylvania, Pennsylvania and New Jersey, and New Jersey and Delaware. The Schuylkill and Lehigh rivers are its main tributaries.

The Delaware serves as a water transportation route for Philadelphia; Trenton and Camden, New Jersey; and Wilmington, Delaware, all of which help form one of the nation's great industrial areas. The Chesapeake and Delaware Canal connects the river with Chesapeake Bay. In 1961, the Delaware Basin Compact created a regional administrative agency to develop and control the water resources of the Delaware River Basin. Peter W. Rees

See also **Delaware Bay; Pennsylvania** (picture).

Delaware Water Gap is a deep, narrow *gorge* (valley) cut through the Kittatinny Mountains east of Stroudsburg, Pennsylvania. The Delaware River carved the winding path out of solid rock millions of years ago. The gap is about 3 miles (5 kilometers) long and has steep walls that rise more than 1,200 feet (360 meters) on each side. Highways follow the river's path through the gorge. Mount Tammany stands on the New Jersey side of the gap, and Mount Minsi is located on the Pennsylvania side. The gap and the area around it form the Delaware Water Gap National Recreation Area

William C. Rense

De La Warr, Lord (1577-1618), became the first governor of the Virginia colony. He was also known as *Lord Delaware.* The Delaware River, Delaware Bay, the colony of Delaware, and the state of Delaware were named for him. De La Warr arrived with supplies at Jamestown, Virginia, in June 1610, in time to prevent the discouraged settlers from deserting the colony. He returned to England in 1611. As governor he was harsh and strict, but he succeeded in bringing order to the colony. He became a member of the Privy Council of Queen Elizabeth I.

De La Warr was probably born at Wherwell, England, near Winchester. His given and family name was Thomas West. Fred W. Anderson

See also **Delaware; Jamestown.**

DeLay, Thomas Dale (1947-), a Texas Republican, has been a member of the United States House of Representatives since 1985. He became the majority *whip* (assistant leader) in 1995. As majority whip, DeLay is the third most powerful Republican in the House. He ranks after the speaker of the House and the majority leader. He is also a member of the Appropriations Committee, which makes decisions on funding requests from government agencies.

DeLay was one of the strongest Republican supporters of impeachment proceedings against President Bill Clinton for Clinton's actions involving an affair with a White House intern. The House voted to impeach Clinton in 1998, but the Senate acquitted him in 1999.

DeLay was born in Laredo, Texas. He attended Baylor University and received a bachelor's degree from the University of Houston in 1970. After graduation, he worked for a company that manufactured pesticides and then started his own exterminating business in 1973. He was elected to the Texas House of Representatives in 1978 and served until 1984. Jackie Koszczuk

Delbrück, Max. See Nobel Prizes (table: Nobel Prizes for physiology or medicine—1969).

Del Cano, Juan Sebastián. See Magellan, Ferdinand (The end of the voyage).

Delegate is a representative chosen by a group to speak or act in its interests. National governments send

delegates to international meetings. Delegates to a national political convention are chosen by the states they represent. The states determine the method of selection. They generally use either the primary (popular election) or the state party convention. More delegates may be chosen than the state has votes, in which case there are fractional votes. Ned A. Shearer

De León, Juan Ponce. See Ponce de León, Juan.

De Lesseps, *duh LEHS ehps,* **Ferdinand Marie** (1805-1894), was a French canal builder and diplomat. In 1854, Said Pasha, ruler of Egypt, invited him to start preparatory work on the Suez Canal. De Lesseps's plans provided for a canal without locks, extending from Port Said to Port Tewfik, connecting the Mediterranean Sea with the Gulf of Suez and the Red Sea. The company he organized started work on the Canal in 1859, and completed it 10 years later (see **Suez Canal**).

De Lesseps was born on Nov. 19, 1805, in Versailles. From 1825 until his resignation in 1849, he worked in the French consular and diplomatic service. He was a member of the French Academy and the Academy of Science. At 74, De Lesseps reluctantly agreed to head the French company formed to build the Panama Canal (see **Panama Canal** [The French failure]). Justin McCarthy

Delft (pop. 91,941) is a Dutch town located near The Hague. For location, see **Netherlands** (map). Many of Delft's old buildings and picturesque canals have been preserved. One famous building, the Prinsenhof, now a museum, is the place where William I of Orange was assassinated in 1584. The Nieuwe Kerk (New Church), built in the 1400's, contains the tombs of William I and other rulers of the House of Orange. Many painters, including Jan Vermeer and Pieter de Hooch, lived and worked in Delft.

The manufacture of blue pottery was once Delft's most famous industry. Only a few craftspeople continue the tradition. Today, Delft produces metal and electrical machinery. It is the home of Delft University, a large technical university. Jan de Vries

Delft is a type of earthenware that was made in the late 1500's and flourished into the mid-1700's. It is named for the town of Delft in the Netherlands, a center of production. About the same time, potters in England made a similar pottery also called delft. Delft was glazed with tin oxide to produce a creamy white surface. Designs were painted with other metallic oxides that turned various colors when the pottery was *fired* (baked). Delft resembles pottery called *faïence* and *majolica.* The three types differ in the style of their decoration. See **Faïence; Majolica.**

Corcoran Gallery of Art, Washington, D.C., William A. Clark Collection

A delft vase

Delft of the early 1600's imitated Chinese porcelain. By the 1700's, potters had adopted European stylistic characteristics and subject matter. Dutch delft often shows historical events, landscapes, or scenes of daily life. Much English delft is decorated with simple mottoes or portraits of monarchs. Some delft is still produced today. John W. Keefe

Delgado, *dehl GAH doh,* **José Matías,** *hoh SAY mah TEE ahs* (1767-1832), a Salvadoran priest and patriot, is called the father of his country. He led the people of El Salvador in three revolutions for their freedom and became the nation's hero.

Many Latin American countries revolted against Spain in 1810. Delgado directed the revolt in El Salvador in 1811. The Spaniards quickly put it down. The Central American countries finally won their independence from Spain in 1821. When Mexico tried to include them in its empire in 1822, Delgado headed the resistance movement in El Salvador. He was president of the congress that drew up a constitution for the United Provinces of Central America, a union of nations that existed from 1823 to the late 1800's. Disappointed in the union, Delgado began a campaign against neighboring countries but died before the battle ended. He was born on Feb. 24, 1767, in San Salvador. John A. Booth

Delhi, *DEHL ee* (pop. 9,817,439; met. area pop. 12,791,458), is the second largest city in India. Only Mumbai has more people. Delhi lies on the Yamuna River in northern India (see **India** [political map]). It was India's capital from 1912 until 1931, when the present capital, New Delhi, was established just south of Delhi.

The city. The central section of Delhi is within the ruins of walls that were built in the mid-1600's. Three of the city's original 14 gates are still standing.

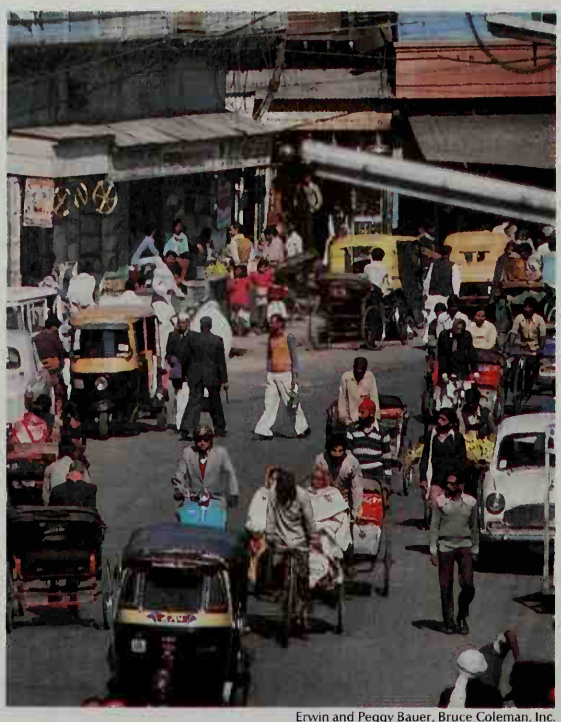
Delhi is an old, crowded city with many narrow streets and slum dwellings. These features contrast sharply with the wide boulevards and modern buildings in some parts of the city and in New Delhi. Many of Delhi's industries are in heavily populated residential areas. The location of these industries is partly responsible for the city's crowded living conditions.

The busiest street in Delhi is Chandni Chowk, a name that means *silver street.* It is lined with tiny shops, in which silversmiths and other craftworkers produce exquisite products. The many beautiful landmarks in Delhi stand out against their dingy surroundings. The Red Fort, one of the city's most impressive monuments, was built between 1639 and 1648 by the Mughal Emperor Shah Jahan. This red sandstone structure covers several blocks. The remains of the imperial palace and other Mughal structures lie within its walls.

Another famous monument of the mid-1600's is the Jama Masjid, a majestic marble and sandstone mosque with three marble domes. Between Delhi and New Delhi is a shrine called the Rajghat. It marks the place where the body of the Indian leader Mohandas K. Gandhi was cremated in 1948. Delhi is the home of the University of Delhi and a number of colleges.

Economy. Delhi is a major center of government and finance in India. It is also an important manufacturing and transportation center. The city's leading manufactured products are electrical machinery and equipment, metal products, and rubber. Railroads are the most valuable part of the city's transportation industry.

History. The Delhi area has been the site of many cities from ancient times to today. Much of the present city



Erwin and Peggy Bauer, Bruce Coleman, Inc.

Delhi, India's second largest city, is old and crowded. Its residential areas are also the site of many of the city's industries, which adds to the congestion.

was built by Shah Jahan and other Mughal emperors during the 1600's. The British captured the city in 1803 and moved the Indian capital from Calcutta (now Kolkata) to Delhi in 1912. They soon began to build New Delhi, which replaced Delhi as the capital in 1931.

Great industrial growth took place in Delhi after India gained independence from Britain in 1947. The city's population began to increase greatly at the same time. This increase resulted partly from the arrival of thousands of Indian refugees from the newly independent nation of Pakistan nearby. Delhi's population is six times larger than it was in 1951.

In 1955, the government started a program to direct the growth of Delhi. New residential and industrial areas have been created, but the city still faces many problems caused by its rapid growth. Robert LaPorte, Jr.

See also New Delhi.

Delhi Sultanate, *DEHL ee SUHL tuh nayt,* was a Muslim military state that extended across much of what is now Bangladesh, India, and Pakistan from 1206 to 1526. The sultanate's boundaries shifted, depending on its military strength, but it centered in the Ganges Valley and Punjab. Delhi was the capital. The sultans were of Turkish (central Asian) or Afghan background.

In the late 1100's, Muhammad of Ghor, a Turkish Muslim king, seized much of northern India. In 1206, a sultanate was established at Delhi. During the 1200's, the sultans successfully defended their territory from the remaining Hindu and Buddhist kings. They also prevented the Mongols, who had already conquered China and the Middle East, from conquering India.

During the 1300's, the sultanate temporarily extended its power far into southern India. In 1398, however, the conqueror Timur (also called Tamerlane) looted and destroyed Delhi and massacred most of its people. Although the sultans regained Delhi after Timur left that same year, their former territory was split into regional kingdoms. Babur, a descendant of Timur, defeated the last sultan in 1526 and established the Mughal Empire.

During the sultanate, central Asian and Middle Eastern Muslims migrated to India to serve as soldiers, government or religious officials, or merchants. Holy men converted some Indians to Islam, the religion of the Muslims. Other Indians switched religions to improve their economic position. Most of the converts lived in the northwest and northeast, now Pakistan and Bangladesh. Patricia Risso

Delibes, *duh LEEB,* **Léo** (1836-1891), was a French composer of works for the stage. During his lifetime, he was best known for his light operas. Today, his reputation rests on three works—the ballets *Coppélia* (1870) and *Sylvia* (1876) and the opera *Lakmé* (1883). Music from both ballets has been adapted into popular orchestral suites. *Lakmé* contains the famous "Bell Song," an aria for coloratura soprano. The three compositions reflect Delibes's brilliant orchestral writing, rhythmic subtlety, and easily remembered melodies. His other works include music for an 1882 revival of Victor Hugo's play *Le Roi s'amuse* and a collection of 15 songs, published in 1885 or 1886. The collection includes the popular "The Girls of Cadiz."

Delibes was born on Feb. 21, 1836, in St. Germain du Val, near Le Mans. His full name was Clément Philibert Léo Delibes. He studied composition at the Paris Conservatory from 1848 to 1852 and composed his first work, an operetta, in 1855. He worked as an organist for a number of years, but he was primarily concerned with composing operas and ballets. Daniel T. Politoske

Delilah, *dih LY luh,* in the Old Testament, was the Philistine mistress of Samson, the Israelite folk hero famed for his tremendous strength. The Philistines, who were enemies of the Israelites, bribed Delilah to find out the secret of Samson's power so that they could take him prisoner. After much coaxing, Samson told Delilah that his strength lay in his long, thick hair which, because of a vow, he had never cut. Delilah had his head shaved while he was asleep. He became weak and helpless. The Philistines easily captured him, blinded him, and made him work as a slave. The story of Samson is told in Judges 16. J. Maxwell Miller

Delinquency, Juvenile. See **Juvenile delinquency.**

Delirium tremens, *dih LIHR ee uhm TREE muhnz,* often called the *DT's,* is a nervous and mental disturbance that results from acute alcoholism. It occurs after withdrawal from alcohol or other depressant drugs and may last 3 to 10 days. People often become markedly disturbed after prolonged or heavy drinking of alcoholic beverages. They develop insomnia and a dislike for food, and become irritable and restless. They may then have visual illusions and hallucinations. These visions may be brief but terrifying. In some cases, they may last several days. Death sometimes results, often because pneumonia develops or heart failure occurs. Doctors usually treat DT's by taking alcohol away from patients and giving them sedative and tranquilizing drugs. See also **Alcoholism.** Kenneth Blum and Ronald W. McNichol

Delius, *DEE lee uhs,* **Frederick** (1862-1934), was an English composer. He wrote in many forms but is best known for compositions that combine chorus, vocal soloists, and orchestra. These works include *Sea Drift* (1906), based on the poetry of the American poet Walt Whitman; and *A Mass of Life* (1908-1909), based on texts by German philosopher Friedrich Nietzsche. Delius also composed chamber music, concertos, operas, songs, symphonic tone poems, and incidental music for plays. Important works include *On Hearing the First Cuckoo in Spring* (1913), *Summer Night on the River* (1913), and *Fennimore and Gerda* (written, 1909-1910; performed, 1919). Delius's finest music generates emotional power by blending simple melodies with rich and subtle harmonies.

Delius was born in Bradford. His given and family name was Fritz Theodore Albert Delius. In 1884, he moved to Florida, where he was influenced by black folk music. After living in Virginia in 1885, he returned to Europe in 1886. In his mature style, he combined this influence with elements from such European composers as Claude Debussy, Edvard Grieg, and Richard Wagner.

Vincent McDermott

Della Chiesa, Giacomo. See Benedict XV.

Della Francesca, Piero. See Piero della Francesca.

Della Robbia, Andrea. See Della Robbia, Luca.

Della Robbia, *DEHL uh ROH bee uh,* **Luca** (1399?-1482), was an Italian sculptor of the early Renaissance. Della Robbia created works in bronze and marble, but he is best known for his sculpture in terra cotta, which is a type of hard, durable earthenware. Della Robbia covered his terra cottas with glazes of bright colors, usually white against a blue background. These glazed terra cottas were less expensive to make than marble and they were also more durable than paint.

Glazed terra cotta statue (about 1450); Museo Nazionale, Florence (SCALA/Art Resource)

Luca della Robbia created *Madonna and Child Jesus.*

The first work known to be by della Robbia—and one of his most famous—is the *Cantoria,* or *Singing Gallery* (1431-1438). The *Cantoria* consists of 10 panels that portray children in relief sculpture singing and playing musical instruments. The panels are framed by delicately carved neoclassical architecture. The work illustrates the Biblical text of Psalm 150. The *Cantoria* was originally located over a doorway in the Cathedral of Florence and is now in the Cathedral museum. A detail of the *Cantoria* appears in **Classical music** (Highlights in the history of classical music). Della Robbia was born in Florence.

Luca della Robbia's nephew Andrea della Robbia was a pupil of his uncle and inherited the family workshop in Florence. Andrea continued to make glazed terra cottas, though he lacked Luca's originality and power. Five of Andrea della Robbia's sons were trained in the della Robbia workshop and became recognized sculptors.

David Summers

Dello Joio, *DEHL oh JOY oh,* **Norman** (1913-), is an American composer. He won the 1957 Pulitzer Prize in music for his *Meditations on Ecclesiastes* (1957) for orchestra. Dello Joio's style reflects the influence of American jazz, Italian opera, and a movement of the early 1900's called *neoclassicism.* His music features highly developed rhythms and lyrical melodies.

Dello Joio has composed for orchestra, band, chamber groups, chorus, piano, and solo voice. He has written operas, ballets, and music for television. Two of Dello Joio's most impressive compositions are *The Mystic Trumpeter* (1943) and *A Jubilant Song* (1946). He adapted these choral works from the poetry of the American poet Walt Whitman. A number of Dello Joio's pieces are variations on a single theme. Examples of such variations include *Variations, Chaconne, and Finale* (1948) for orchestra.

Dello Joio was born in New York City. He has worked as an organist and choirmaster in several Roman Catholic churches.

Leonard W. Van Camp

Dells. See Dalles.

Deloria, Vine, Jr. (1933-), is a leader in the fight for Indian rights in the United States. He is a principal spokesman in the struggle of Indians to gain greater control over their own affairs. Deloria, a Sioux Indian, supports a return to tribal religions and certain other Indian attitudes toward life. He has written several books about current Indian life. His best-known work, *Custer Died for Your Sins* (1969), deals with the treatment of Indians by whites and the goals of Indian leaders.

George Janoff

Vine Deloria, Jr.

From 1964 to 1967, Deloria directed the National Congress of American Indians. This private organization serves the economic and legislative interests of

Indians. In 1971, he cofounded a law firm called the Institute for the Development of Indian Law. The institute defends treaty rights of various tribes.

Vine Victor Deloria, Jr., was born in Martin, South Dakota, and graduated from Iowa State University in 1958. He earned a master's degree at the Lutheran School of Theology in 1963 and a law degree at the University of Colorado in 1970. His other books include *We Talk, You Listen* (1970), *God Is Red* (1973), and *Behind the Trail of Broken Treaties* (1974). Beatrice Medicine

De los Angeles, Victoria (1923-), a Spanish lyric soprano, won international acclaim as an opera singer, a recitalist, and an orchestral soloist. She became famous for her performances in such operatic roles as Mimi in *La Bohème* and Manon in *Manon.* Critics consider de los Angeles one of the finest performers of French songs and a distinguished interpreter of Spanish folk songs. Her voice is rich and flexible and has a slightly melancholy tone.

De los Angeles's real name is Victoria de los Angeles Lopez Garcia. De los Angeles was born in Barcelona and studied at the Barcelona Conservatory. She made her operatic debut in Barcelona in 1945 as the Countess in *The Marriage of Figaro,* and her Metropolitan Opera debut in 1951 as Marguerite in *Faust.* Thomas Bauman

Delphi, *DEHL fy,* was a town situated on the southern slope of Mount Parnassus. The town had the oldest and most influential religious sanctuary in ancient Greece. It was in the district of Phocis.

The ancient Greeks believed that the site of Delphi was sacred to the god Apollo. It gained importance as early as the 1100's B.C. Later, the site of Delphi became an international Greek shrine. The sanctuary of Delphi contained the main temple of Apollo, a stadium, and a theater. It also included many small buildings and monuments. The ancient Greeks held the Pythian Games in Delphi.

The temple contained the famous *oracle,* or prophet (see **Oracle**). A woman oracle, called Pythia, would utter weird sounds while in a frenzy. People believed these were the words of Apollo. Temple priests interpreted these to the public.

Cities, as well as private individuals, sought the oracle's advice. As a result, the oracle greatly influenced Greek religion, economics, and politics. This influence gradually waned in later Greek and Roman times. The Christian Roman emperor Theodosius closed the sanctuary in A.D. 390.

French scholars began excavations in 1880. The present-day village of Delphi, formerly called Kastri, is near the site of ancient Delphi. Ronald P. Legon

See also **Apollo**.

Delta is a low plain composed of clay, sand, gravel, and other sediments deposited at the mouth of a river. Deltas are named for the Greek letter *delta* (Δ) because many of them have a roughly triangular shape. The Greek historian Herodotus first applied the term in the mid-400's B.C. Deltas form when rivers flow into large bodies of standing water, where their speed and ability to carry sediments are suddenly reduced.

The chief factors that affect the formation of deltas include climate, geological features, river size and flooding patterns, and the strength of ocean waves. Dams and other structures also influence the development of

The Nile Delta

The Mississippi Delta

WORLD BOOK maps

deltas. For example, construction of the Aswan High Dam in Egypt during the 1960's decreased the amount of sediments that the Nile River carries to its delta. As a result, waves are destroying parts of the Nile Delta.

Deltas have fertile soil that makes them excellent agricultural areas. The rich land of the Mississippi Delta in Louisiana produces fruits, vegetables, and other crops. The Nile Delta has been farmed since ancient times. Some deltas, such as the Irrawaddy Delta in Burma and the Mekong Delta in Vietnam, support vast rice fields. J. M. Coleman

See also **Erosion** (How erosion occurs); **Louisiana** (picture: Mississippi Delta).

Deluge, *DEHL yooj,* according to the Bible, was a great flood that covered the earth thousands of years ago. The Deluge destroyed all living things except those that God permitted to go aboard a huge ark that was built by Noah.

The Deluge is described in two accounts combined in Genesis 6 to 8. In one version, God instructs Noah to save one male and one female of every animal. In the other, God tells Noah to take seven pairs of animals considered "clean" according to ancient dietary laws and one pair of "unclean" animals. Both Biblical accounts agree that God sent the flood to punish the wickedness of humanity.

Stories about great floods occur in the religious tradition of many peoples. A famous account is found in the Epic of Gilgamesh from Mesopotamia. Many scholars believe the Mesopotamian and Biblical accounts are related. H. Darrell Lance

See also **Ararat; Ark; Deucalion; Noah.**

Delusion, *dih LOO zhuhn,* is a false belief. Persons with mental illness often have delusions. A common delusion is that of *grandeur,* in which people have an exaggerated idea of their importance. Other delusions include *persecution,* in which people believe they are being mistreated, and *reference,* in which they falsely believe they are being talked about. Paula J. Clayton

Demand. See **Supply and demand.**

Demarcation, Line of. See **Line of Demarcation.**

De Maupassant, Guy, *GEE* (1850-1893), a French author, is considered one of the world's great short-story writers. De Maupassant wrote clearly and simply. His tales are realistic and reflect his often brutally sarcastic and pessimistic attitude toward people. De Maupassant wrote with sympathy only about the poor and outcasts of society.

De Maupassant's stories deal with many subjects—the middle class, peasants, government officials, the

Franco-Prussian War, outdoor life, animals, and ghosts. He wrote about 250 stories, most of them between 1880 and 1890. He published them in several collections. The best known include *The Tellier House* (1881), *Yvette* (1885), *Toine* (1886), and *The Horla* (1887). His most famous stories include "Ball-of-Fat," "The Diamond Necklace," "The Umbrella," and "The Piece of String."

De Maupassant's novels have the same qualities his short stories have. *A Woman's Life* (1883) is a portrait of an unhappy country wife. *Bel-Ami* (1885) describes the rise of an unprincipled journalist. *Peter and John* (1888) is a psychological study of two brothers.

De Maupassant was born in Normandy, in northern France. He learned much of his literary technique and philosophy of life from his godfather, the famous French novelist Gustave Flaubert. De Maupassant died in an insane asylum. Thomas H. Goetz

Demeter, *dih MEE tuhr,* was a goddess of fertility in Greek mythology. Her name probably means *Mother Earth* or *Mother Grain.* Demeter was associated especially with grain. For this reason, the Romans later identified her with their harvest goddess, Ceres.

Demeter was a daughter of the god Cronus and goddess Rhea. She had children by Zeus, king of the gods, and the ocean god Poseidon. In Arcadia, in southern Greece, both Demeter and Poseidon were worshiped in the form of horses.

The only significant myth about Demeter tells of her search for her daughter Persephone. Persephone had been kidnapped by Hades, the god of the underworld, to be his bride. For details of this myth, see **Persephone.**

Demeter's greatest festival, the Eleusinian Mysteries, took place in Eleusis, near Athens. However, many communities celebrated other rites honoring Demeter. The Eleusinian Mysteries were held shortly before the autumn planting. A rule of secrecy surrounded the festival, and so few details about it are known. However, the rite must have been concerned at first with the death and rebirth of grain. Later, the worship included a belief in the immortality of the soul. F. Carter Philips

See also **Mysteries; Ceres.**

De Mille, Agnes (1905-1993), was an American *choreographer* (creator of dances), dancer, and author. She began her career as a dancer in 1929 and gave concerts in the United States and Europe until 1940. She then began creating ballets based on American themes. The first was *Rodeo* (1942). In 1943, she created and staged the dances for the musical play *Oklahoma!* This landmark musical was one of the first to successfully blend dancing, story, and music into a unified work. Many of her ballets are regularly performed by the American Ballet Theatre, including *Fall River Legend* (1948).

Agnes George de Mille was born in New York City. She wrote the autobiographies *Dance to the Piper* (1952), *And Promenade Home* (1958), and *Where the Wings Grow* (1978). She also wrote *Martha: The Life and Work of Martha Graham* (1991). Selma Landen Odom

See also **Ballet** (picture: Ballet in musical comedies).

De Mille, Cecil Blount (1881-1959), a motion-picture producer and director, became famous for his spectacular Biblical epics. His first Biblical film was *The Ten Commandments* (1923). His final film as a director was a remake of this picture in 1956. A shrewd showman, De Mille balanced religion with romance in such films as *The Sign of the Cross* (1932) and *Samson and Delilah* (1949). His striking drama of Jesus Christ, *The King of Kings* (1927), was one of the few De Mille Biblical films to win praise from both critics and the clergy. He also made romantic adventures, including *The Plainsman* (1937), *Union Pacific* (1939), and *Unconquered* (1947). His circus spectacle, *The Greatest Show on Earth,* won the 1952 Academy Award for best picture.

De Mille was born in Ashfield, Massachusetts, and went to Hollywood in 1913. His early silent films, including *Male and Female* (1919) and *Forbidden Fruit* (1921), generally dealt with romantic entanglements in high society. Gene D. Phillips

Deming, W. Edwards (1900-1993), was an American management consultant often called the father of the quality management movement. His teachings were considered a leading influence in the revival of the Japanese economy after Japan's defeat in World War II (1939-1945). In the 1980's, major corporations in the United States and other countries began to adopt his principles.

Deming developed a quality management system that emphasized joy in work and pride in the outcome. He said that quality should be stressed at each step of a process and not only by inspecting the product or service once it is completed. In addition, Deming maintained that most product and service problems result from faults in management rather than from the carelessness of workers.

William Edwards Deming was born in Sioux City, Iowa. He received a doctor's degree in mathematical physics from Yale University in 1928. He was a mathematical physicist at the U.S. Department of Agriculture from 1927 to 1939. During World War II, he taught engineers how to use statistics to increase the production of war supplies.

In 1950, a group of Japanese scientists and engineers invited Deming to Japan to lecture on principles of quality control. Some Japanese companies that applied his methods increased their productivity and earned large profits, and his ideas spread. In addition to his work as a management consultant, Deming was a professor of statistics at New York University from 1946 to 1993.

Howard Seth Gitlow

Fred Fehl

Agnes de Mille danced in the 1942 premiere of her ballet *Rodeo* with Casimir Kokitch, *left,* and Frederic Franklin, *right.*

Democracy is a form of government, a way of life, a goal or ideal, and a political philosophy. The term also refers to a country that has a democratic form of government. The word *democracy* means *rule by the people.* United States President Abraham Lincoln described such self-government as "government of the people, by the people, for the people."

The citizens of a democracy take part in government either directly or indirectly. In a *direct democracy,* also called a *pure democracy,* the people meet in one place to make the laws for their community. Such democracy was practiced in the ancient Greek city-state of Athens and exists today in the New England town meeting (see **Town meeting**).

Most modern democracy is *indirect democracy,* which is also known as *representative democracy.* In large communities—cities, states, provinces, or countries—it is impossible for all the people to meet as a group. Instead, they elect a certain number of their fellow citizens to represent them in making decisions about laws and other matters. An assembly of representatives may be called a council, a legislature, a parliament, or a congress. Government by the people through their freely elected representatives is sometimes called a *republican government* or a *democratic republic.*

Many voting decisions in democracies are based on *majority rule*—that is, more than half the votes cast. A decision by *plurality* may be used when three or more candidates stand for election. A candidate with a plurality receives more votes than any other candidate, but does not necessarily have a majority of the votes. In several democracies, elections to legislative bodies are conducted according to *proportional representation.* Such representation awards a political party a percentage of seats in the legislature in proportion to its share of the total vote cast.

Throughout history, the most important aspects of the democratic way of life have been the principles of individual equality and freedom. Accordingly, citizens in a democracy should be entitled to equal protection of their persons, possessions, and rights; have equal opportunity to pursue their lives and careers; and have equal rights of political participation. In addition, the people should enjoy freedom from undue interference and domination by government. They should be free, within the framework of the law, to believe, behave, and express themselves as they wish. Democratic societies seek to guarantee their citizens certain freedoms, including freedom of religion, freedom of the press, and freedom of speech. Ideally, citizens also should be guaranteed freedom of association and of assembly, freedom from arbitrary arrest and imprisonment, and freedom to work and live where and how they choose.

Some people in democratic states have been eager to increase the role of government in society in order to make material conditions more equal for everyone. But other people have been concerned that the extension of government's role in such areas as welfare, education, employment, and housing may decrease the freedom of the people and subject them to too much government

Famous quotations about democracy

The views below explain the meaning of democracy as a form of government, a way of life, and a goal or ideal. Views on the benefits of rule by law have been expressed since democracy began to develop in ancient Greece as early as the 600's B.C.

The basis of a democratic state is liberty.

Aristotle

As I would not be a slave, so I would not be a master. This expresses my idea of democracy. Whatever differs from this, to the extent of the difference, is no democracy.

Abraham Lincoln

The measure of a democracy is the measure of the freedom of its humblest citizens.

John Galsworthy

I believe in democracy because it releases the energies of every human being.

Woodrow Wilson

Never in the history of the world has a nation lost its democracy by a successful struggle to defend its democracy.

Franklin D. Roosevelt

Government of the people, by the people, for the people, still remains the sovereign definition of democracy.

Sir Winston Churchill

My political ideal is democracy. Everyone should be respected as an individual, but no one idolized.

Albert Einstein

Democracy is the recurrent suspicion that more than half of the people are right more than half of the time.

E. B. White

Democracy...is the only form of government that is founded on the dignity of man, not the dignity of some men, of rich men, of educated men or of white men, but of all men.

Robert Maynard Hutchins

Each person quoted above has a biography in WORLD BOOK.

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Free elections are held regularly in a democracy. The people use a secret ballot to elect officials to represent them and to run the government on all levels.

regulation. The division between these groups has helped furnish one of the main themes of controversy and discussion in modern democratic societies.

Applying democratic principles in everyday life can be challenging. In the United States, for example, freedom of speech, press, religion, and assembly are protected by the First Amendment to the Constitution. In guarding these freedoms, the U.S. judiciary has tried to balance the interests of individuals against possible injury and damage to other people and the community. Thus, the right of free speech does not allow people to falsely damage the reputations of others.

This article presents a broad survey of democracy—what it is, how it works, and how it has developed. For more information on democracy and other forms of government, see the article on Government.

Features of democracy

The characteristics of democracy vary from one country to another. But certain basic features are more or less the same in all democratic nations.

Free elections give the people a chance to choose their leaders and express their opinions on issues. Elections are held periodically to ensure that elected officials truly represent the people. The possibility of being voted out of office helps assure that these officials pay attention to public opinion.

In most democracies, the only legal requirements for voting or for holding public office have to do with age, residence, and citizenship. The democratic process permits citizens to vote by secret ballot, free from force or bribes. It also requires that election results be protected against dishonesty. See **Election.**

Majority rule and minority rights. In a democracy, a decision often must be approved by a majority of voters before it may take effect. This principle, which is called majority rule, may be used to elect officials or decide a policy. Democracies sometimes decide votes by plurality. Most democracies require more than a simple majority to make fundamental or constitutional changes. In the United States, for example, constitutional amendments must be ratified by the legislatures of three-fourths of the states or by special conventions called in three-fourths of the states.

Majority rule is based on the idea that if all citizens are equal, the judgment of the many will be better than the judgment of the few. Democracy values freely given consent as the basis of legitimate and effective political power. But democracies are also concerned with protecting individual liberty and preventing government from infringing on the freedoms of individuals. Democratic countries guarantee that certain rights can never be taken from the people, even by extremely large majorities. These rights include the basic freedoms of speech, press, assembly, and religious worship. The majority also must recognize the right of the minority to try to become the majority by legal means.

Political parties are a necessary part of democratic government. Rival parties make elections meaningful by giving voters a choice among candidates who represent different interests and points of view.

The United States and the United Kingdom have chiefly *two-party systems.* Many democratic countries have *multi-party systems,* which have more than two major parties. Often in these countries, no single party gains a majority in the legislature. As a result, two or more parties must join to make up such a majority. These parties form a *coalition government.* In democratic countries, the party or parties that are out of power serve as the "loyal opposition." That is, they criticize the policies and actions of the party in power. In dictatorships, the people have no real choice among candidates, and no opportunity to express dissatisfaction with the government. See **Political party.**

Controls on power. Democracies have various arrangements to prevent any person or branch of government from becoming too powerful. For example, the U.S. Constitution divides political power between the states and the federal government. Some powers belong only to the states, some only to the federal government, and some are shared by both. This arrangement, known as *federalism,* is also used in such democracies as Canada, Germany, and Switzerland. See **Federalism.**

The Constitution further divides the powers of the U.S. government among the President, Congress, and the federal courts. The power of each branch is designed to check or balance the power of the others. See **Checks and balances.**

In all democratic countries, government officials are subject to the law and are accountable to the people. Officials may be removed from office for lawless conduct or for other serious reasons. The communications media help keep elected officials sensitive to public opinion. See **Government** (The organization of government).

Constitutional government. Democratic government is based on law and, in most cases, a written constitution. Constitutions state the powers and duties of government and limit what the government may do. Constitutions also say how laws shall be made and enforced. Most constitutions have a detailed bill of rights that describes the basic liberties of the people and forbids the government to violate those rights. See **Bill of Rights.**

Constitutions that have been in effect for a long time may include certain unwritten procedures that have become important parts of the operation of government. Such procedures are a matter of custom rather than written law. The United Kingdom, for instance, has no single written document called "the constitution." In that country, however, certain customs and conventions, as well as certain major documents and many laws, are widely accepted as the basic rules of the system. See **Constitution.**

An essential characteristic of democratic government is an independent judiciary. It is the duty of the justice system to protect the integrity of the rules and the rights of individuals under these rules, especially against the government itself.

Occasionally, dictatorships establish extremely elaborate constitutions and extensive lists of basic rights of citizens. For example, the 1977 constitution of the Soviet Union contained more detailed rights supposedly guaranteed to citizens than does the U.S. Bill of Rights. In practice, however, Soviet courts were not known to defend individuals' rights against the government.

Private organizations. In a democracy, individuals and private organizations carry on many social and eco-

nomic activities that are, for the most part, free of government control. For example, newspapers and magazines are privately owned and managed. Labor unions are run by and for the benefit of workers, not the state. Democratic governments generally do not interfere with religious worship. Private schools operate along with public schools. The people may form groups to influence opinion on public issues and policies. Most businesses in democratic societies are privately owned and managed.

In dictatorial societies, the government alone may organize and control most associations. The people are not permitted to establish or join most groups without the permission of the state. In some countries, the government owns and manages much of the economy. However, such arrangements have been less common since the collapse of Communism in Eastern Europe in the early 1990's.

Making democracy work

In most democracies, there are extensive programs to provide economic security, to improve education, to ease suffering, and to develop human potential. Many democracies aim to provide a minimum standard of living and adequate medical care for all. A society must be stable and informed for its democratic institutions to function with maximum effectiveness.

Citizen participation. Democracy calls for widespread participation in politics by the people. It is believed to be the duty of all adult citizens to vote in local, state or provincial, and national elections. Qualified individuals should be willing to run for public office, to serve on juries, and to contribute to the welfare of their country. Citizens should help shape public opinion by speaking out on important issues and by supporting the political party of their choice. An active citizenry is thought to be one of the best guarantees against corrupt and inefficient government.

Education and democracy. Faith in the power of education is a characteristic of democracy. According to democratic ideals, widespread participation in politics does not necessarily ensure good government. The quality of government depends on the quality of participation. Well-informed and well-educated citizens are able to participate more intelligently.

A democracy needs educated citizens who can think for themselves. Citizens have a duty to take part in public affairs, to keep informed on public issues, and to vote intelligently. Democratic institutions must produce leaders worthy of public trust and responsibility. For this reason, democratic governments support education for their citizens.

Voluntary action. An important quality of democratic government is its emphasis on trying to get people to act on the basis of understanding and agreement instead of force. Although governments must use force sometimes, democracies usually emphasize dialogue, negotiation, bargaining, and ultimately, voluntary citizen cooperation. This approach is closely linked to the widely held democratic belief that people are generally rational and well disposed toward the common welfare.

Economic development and agreement on fundamentals. Most successful democracies have existed in developed societies. In such societies, literacy rates and *per capita* (per person) incomes are relatively high. Some scholars believe democracy works best in countries with a large middle class.

Many democratic governments have collapsed during economic crises. The basic problem involved in the failures of such democracies has been the inability to maintain sufficient agreement among either the people or their political leaders on the purposes of government. Crises have often aggravated and sharpened divisions and suspicions among various classes, groups, parties, and leaders. Excessive divisions have at times blocked action by freely elected governments, often resulting in widespread public frustration and disorder.

Democratic governments are likely to be unstable whenever people become deeply divided and suspicious of one another. Sometimes racial, ethnic, or religious differences make democracies difficult to operate. In the 1960's and 1980's, for example, intense ethnic conflicts led to the collapse of newly founded democratic governments in Nigeria. In such instances, the people may not see one another as legitimate and trustworthy partners in the enterprise of government.

The development of democracy

Origins of democracy. Democracy began to develop in ancient Greece as early as the 500's B.C. The word *democracy* comes from the Greek words *demos,* meaning *people,* and *kratos,* which means *rule* or *authority.* Greek political thinkers stressed the idea of rule by law. They criticized dictatorship as the worst form of government. Athens and some other Greek city-states had democratic governments.

Democracy in ancient Athens differed in important ways from democracy today. Athenian democracy was a direct democracy rather than a representative one. Each male citizen had the duty to serve permanently in the assembly, which passed the laws and decided all important government policies. There was no division between legislative and executive branches of the government. Slaves made up a large part of the Athenian population, and did most of the work. Neither slaves nor women could vote.

The ancient Romans experimented with democracy, but they never practiced it as fully as did the Athenians. Roman political thinkers taught that political power comes from the consent of the people. The Roman statesman Cicero contributed the idea of a universal law of reason that is binding on all people and governments everywhere. He suggested that people have natural rights that every state must respect.

The Middle Ages. Christianity taught that everyone is equal before God. This teaching promoted the democratic ideal of brotherhood among people. Christianity also introduced the idea that Christians are citizens of two kingdoms—the Kingdom of God and the kingdom of the world. It held that no state can demand absolute loyalty from its citizens because they must also obey God and His commandments. During the Middle Ages (about the A.D. 400's through the 1400's), the conflict between these two loyalties helped lay the foundation for constitutional government.

The Middle Ages produced a social system known as *feudalism.* Under feudalism, persons pledged their loyalty and services to one another. Although kings often

exercised nearly absolute power over their subjects, individuals had certain rights that other persons were required to recognize. A feudal court system was established to protect these rights. Such courts later led to kings' councils, representative assemblies, and modern parliaments. See **Feudalism.**

The Renaissance and the Reformation. The great cultural reawakening called the Renaissance spread throughout Europe during the 1300's, 1400's, and 1500's. A new spirit of individual thought and independence developed. It influenced political thinking and hastened the growth of democracy. People began to demand greater freedom in all areas of life.

The new independence of the individual found religious expression in the Protestant Reformation. The Reformation emphasized the importance of individual conscience. During the early 1500's, Martin Luther, a leader of the Reformation, opposed the Roman Catholic Church as an intermediary between God and people. A number of Protestant churches were established during the period. Some of these churches practiced the congregational form of government, which had a democratic structure. During the 1500's, both Catholics and Protestants defended the right to oppose absolute monarchy. They argued that the political power of earthly rulers comes from the consent of the people.

Democracy in England. In 1215, English nobles forced King John to approve Magna Carta. This historic document became a symbol of human liberty. It was used to support later demands for trial by jury, protection against unlawful arrest, and no taxation without representation.

English democracy developed slowly during the next several hundred years. In 1628, Parliament passed the Petition of Right. The petition called on King Charles I to stop collecting taxes without the consent of Parliament. It also provided that Parliament should meet at regular intervals. Charles refused to agree to limits on the royal power, and civil war broke out in 1642. The Puritans, led by Oliver Cromwell, fought the followers of the king. Charles was beheaded in 1649, and the Puritans established a short-lived *commonwealth* (republic). See **England** (The Civil War).

The English revolution of 1688 finally established the supremacy of Parliament. John Locke, the philosopher of the revolution, declared that final authority in political matters belonged to the people. The government's main purpose, he said, was to protect the lives, liberties, and property of the people. Parliament passed the Bill of Rights in 1689, assuring the people basic civil rights.

Modern democracy was still far off. The larger factory towns were not represented in Parliament until after the adoption of the Reform Act of 1832. Property qualifications for voting disappeared only gradually. In 1918, for the first time, all men were permitted to vote. Not until 1928 could all women vote.

French contributions to democracy were made in the 1700's by such political thinkers as Montesquieu, Voltaire, and Jean-Jacques Rousseau. Their writings helped bring about the French Revolution, which began in 1789. Montesquieu argued that political freedom requires the separation of the executive, legislative, and judicial powers of government. Voltaire spoke out against government invasion of individual rights and freedoms. Rousseau declared in his book *The Social Contract* (1762) that people "have a duty to obey only legitimate powers." The only rightful rulers, he added, were, ultimately, the people.

The French Revolution, an important event in the history of democracy, promoted the ideas of liberty and equality. It did not make France a democracy, but it did limit the king's powers. See **French Revolution.**

American democracy took root in traditions brought to North America by the first English colonists. The Pilgrims, who settled in Massachusetts in 1620, joined in signing the Mayflower Compact to obey "just and equal laws." The Revolutionary War in America began more than 150 years later, in 1775. The colonists wanted self-government and no taxation without representation. The Declaration of Independence, adopted by the Continental Congress in 1776, is a classic document of democracy. It expressed the belief that "all men are created equal, that they are endowed by their Creator with certain unalienable rights, that among these are Life, Liberty, and the pursuit of Happiness." The Declaration said that the people may change or abolish the government if it interferes with those rights. It established human rights as an ideal by which government must be guided.

Most of the Founding Fathers distrusted the Athenian version of direct democracy. They wanted to establish a republic because they feared that giving the people too much power would lead to mob rule. For this reason, the men who wrote the Constitution of the United States adopted a system of dividing power between the federal government and the states. They also provided that the federal powers be divided among the legislative, executive, and judicial branches. In addition, they provided that the president be elected by an electoral college rather than by the direct vote of the people (see **Electoral college**).

Thomas Jefferson favored a government that would pay more attention to the common citizen. After he became president in 1801, he spoke of his election as a "revolution." In 1828, the election of Andrew Jackson to the presidency further advanced American democracy. The pioneer spirit of the settlers in the West encouraged self-reliance, promoted individual liberty, and gave meaning to the promise of equal opportunity.

By 1850, white males could vote in all the states. The 15th Amendment to the Constitution, adopted in 1870, gave black men the right to vote. In 1920, the 19th Amendment gave women the vote. In 1964, the 24th Amendment prohibited poll taxes as voting requirements in national elections (see **Poll tax**).

The spread of democracy. During the 1800's, democracy developed steadily. Many countries followed the American and British examples. Such democratic institutions as elections and legislatures became common. Where kings still ruled, they lost much of their power and performed mainly ceremonial duties.

The Industrial Revolution brought political changes of great importance. During the second half of the 1800's, the working classes demanded and received greater political rights. New laws gave more citizens the right to vote. The freedoms of speech, the press, assembly, and religion were extended and enlarged. By the 1920's, representative democracy had been established throughout

much of Western Europe, as well as in Australia, Canada, and New Zealand.

Democracy did not take root everywhere, however. Some countries that adopted constitutions modeled after that of the United States later became dictatorships. These nations found that a constitution alone did not guarantee democracy. In Russia, a group of revolutionists set up a Communist dictatorship in 1917 and prevented representative democracy in Russia for decades. Germany adopted a democratic government in 1919, but Adolf Hitler's rise to power brought a fascist dictatorship in 1933. Similar interruptions of democracy occurred in Italy and Spain.

Many other nations—including India, Israel, and Japan—have been democracies since the mid-1900's. The structure of French government has changed many times since the French Revolution, but France has been continuously democratic since the late 1940's. Beginning in the 1950's, newly independent nations in Africa and Asia tried to develop democratic institutions. But inexperience with self-rule, in addition to other problems, made democratic government difficult to achieve.

Since the mid-1970's, democratic government has spread even further. Democracy returned to parts of Europe as dictatorships fell in Portugal and Spain. Beginning in the early 1980's, there was an increase in the number of democratic governments in Latin America, and, to a lesser extent, Southeast Asia. In the late 1980's and early 1990's, democracy increased in northern and central Asia and Eastern Europe as Communists lost control of the governments of the Soviet Union and many Eastern European countries. In 1991, the Soviet Union broke up into a number of independent nations.

Democracy today. Most governments today claim to be democratic, but many lack some essential freedoms usually associated with democracy. In some countries, for example, the people are not allowed basic freedom of speech and of the press, or competitive elections.

One of the most important influences on democracy since the 1970's has been the economic and social *globalization* of the world's nations. Globalization refers to the trend toward increased business, cultural, and government interaction across international borders. Globalization involves the loosening of trade restrictions and the movement of businesses, investments, and workers around the world. It also involves the rapid spread of information, ideas, and values, by means of the Internet and other technological advances in communications.

Some people believe that globalization can encourage the development and practice of democracy worldwide. Increased cultural interaction may help the spread of democratic principles and the reporting of human rights abuses. In addition, democratic countries may be able to use economic pressure to make dictators give up power and establish democracy. Some international economic organizations require nations to establish and maintain democracy before gaining membership.

On the other hand, some people believe that globalization may have negative consequences for democracy. In some cases, a nation's efforts to attract international business and investment may conflict with the needs of the nation's people. Countries may reduce social spending, cut taxes that fund public programs, or eliminate environmental regulations to decrease business costs. In addition, many people are concerned about the growing powers of certain international organizations that are not directly accountable to the people.

Duane Swank

Related articles in *World Book* include:

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Rights of Man, Declaration of the

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Public opinion
Republic
Socialism
Town meeting

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Democratic-Farmer-Labor Party. See Farmer-Labor Party.

Democratic Party is one of the two major political parties of the United States. The Republican Party is the other. The Democratic Party, the nation's oldest existing party, has played a vital role in the history and politics of the United States. From 1828 through 2000, Democrats won 20 of the 44 presidential elections. They dominated U.S. politics from 1828 through 1856, winning 6 of the 8 presidential elections. From 1860 through 1928, they won only 4 of the 18 presidential elections. But the Democratic candidate won 10 of the 18 presidential elections held from 1932 through 2000. Traditionally, the Democratic Party has drawn support from several groups, including many immigrants, Southerners, wage earners, and—since the 1930's—blacks.

The policies of the Democratic Party, like those of other parties, have changed with the flow of history. Until Woodrow Wilson became president in 1913, the Democrats generally approved a strict interpretation of the United States Constitution and favored a limitation on government powers. As president, Wilson expanded the role of government and mobilized the nation to help defeat Germany in World War I (1914-1918). Franklin D. Roosevelt boldly took government action to pull the nation through the Great Depression of the 1930's. During World War II (1939-1945), Roosevelt again expanded government powers to fight Germany and Japan.

Some Democrats thought Roosevelt extended the

government's powers too far. Others believed these powers had not been extended far enough. Ever since Roosevelt's presidency, Democrats have disagreed on how extensive the role of government should be.

This article chiefly describes the history of the Democratic Party. For information about the party's national convention and organization, see the articles on **Political convention** and **Political party**.

Origin of the Democratic Party is uncertain. Some historians trace its beginnings to the Democratic-Republican Party that Thomas Jefferson created during the 1790's (see **Democratic-Republican Party**). Most historians, however, regard Andrew Jackson's presidential campaign organization, formed in 1828, as the beginning of the Democratic Party as it is known today.

Jefferson served as president from 1801 to 1809, and other Democratic-Republicans held the presidency from 1809 to 1825. After 1816, the Democratic-Republican Party split into several groups and fell apart as a national organization. Jackson became the favorite of one of these groups and gained great popularity. He lost a bid for the presidency in 1824. But he easily won election in 1828 and swept to reelection in 1832. By about 1830, Jackson and his followers were called Democrats.

By the late 1830's, top Jacksonian Democrats had turned Jackson's loose organization into an effective national political party—the Democratic Party. One of these men, Martin Van Buren, became president in 1837.

Jacksonian policies appealed to a wide variety of voters. Small farmers, large plantation owners, city laborers, and state bankers joined in their support of the Democratic Party. They had in common a strong belief in states' rights and a firm faith in limited government (see **States' rights**). But Democrats also disagreed frequently. For example, they argued over banking policies, slavery, and tariff rates. In spite of their differences, Democrats won the presidential election of 1844 with James K. Polk. In 1852, they won with Franklin Pierce and in 1856 with James Buchanan. They also controlled Congress during most of the 1840's and 1850's.

The slavery issue, more than any other, divided the Democrats. During Polk's Administration, from 1845 to 1849, vast new territories in the West became part of the United States. Southerners wanted to extend slavery into the new lands, but many Northerners urged Congress to prohibit it.

Fierce debates led to division within the party and to sectional hostility between North and South. Congressional leaders, such as Stephen A. Douglas of Illinois, worked for legislation that would satisfy both Northerners and Southerners. They favored the Compromise of 1850, which, for a time, quieted both party and sectional differences (see **Compromise of 1850**).

Hostility flared again after Congress passed the Kansas-Nebraska Act in 1854. In this act, Douglas had provided for "popular sovereignty," which let settlers decide for themselves whether a new state would permit slavery. The act pleased few people. It led to renewed hostility between North and South and caused the Democratic Party to split apart.

In 1860, Northern Democrats nominated Douglas for president. Southern Democrats chose John C. Breckinridge. Both Democratic candidates lost to Abraham Lincoln, the candidate of the new Republican Party. In 1860 and 1861, 11 Southern states seceded from the Union. In April 1861, shortly after the seventh state had withdrawn, the American Civil War began.

"A LIVE JACKASS KICKING A DEAD LION"
And such a Lion! and such a Jackass!
From *Thomas Nast* by Albert Bigelow Paine, permission of Harper & Bros.

The donkey was used as a political symbol by Andrew Jackson after his opponents called him a "jackass" during the 1828 election campaign. By the 1880's, such cartoons as the one above by Thomas Nast had caught the public eye and established the donkey as the symbol of the Democratic Party.

During the Civil War, the Northern Democrats divided. The "War Democrats" supported Lincoln and the war. The "Peace Democrats," especially those known as "Copperheads," opposed Lincoln and the war. In the election of 1864, many War Democrats supported Lincoln. They joined the Republican Party to form the Union Party. Andrew Johnson, a War Democrat, became Lincoln's vice presidential running mate. The Peace Democrats nominated General George B. McClellan. Lincoln won the election. Following Lincoln's assassination in April 1865—just five days after the war ended—Vice President Johnson became president.

After the Civil War. Republicans condemned the Democrats as disloyal to the Union during the Civil War. Unable to win the presidency or to gain control of Congress, the Democratic Party reached its lowest point.

Under Johnson's leadership, the Democrats attacked the Reconstruction plans of the Radical Republicans for the defeated South (see **Reconstruction**). Among other actions, the Republicans (1) denied the vote to Southerners who had fought against the Union and (2) gave the vote to Southern blacks. Enraged white Southerners deprived blacks of the vote after regaining power later. These white Southerners believed that the Republicans were opposed to most Southern beliefs. Thus, the Democratic "Solid South" was born. During the 1870's, meanwhile, Democrats demanded reforms that would end dishonest practices in business and in government.

A business depression swept the nation during the 1870's and helped change the party's fortunes. Many

voters blamed the Republicans for the depression and voted Democratic in the congressional elections of 1874. As a result, the Democrats gained control of the House of Representatives. In 1876, the Democrats made reform the central issue of their campaign. The Democratic candidate, Samuel J. Tilden, received more popular votes than did his Republican opponent, Rutherford B. Hayes. But Hayes won the election by one electoral vote.

As Civil War issues faded, there seemed to be less and less difference between the Democratic and Republican parties. But the Democrats were distinguished by their support of lower tariffs and by their opposition to the prohibition of alcoholic beverages. The Democrats' image as supporters of states' rights and limited government appealed to white Southerners, small farmers, and many Northerners who associated strong government with prohibition and similar laws. Drawing on this appeal in 1884, Grover Cleveland became the first Democrat to be elected president since 1856. He narrowly lost the presidency to Benjamin Harrison in 1888, but he regained it in another close race in 1892.

Tremendous changes had reshaped the economy since the Civil War. Railroads had expanded to carry goods to farmers and farm products to city workers. Vast business and industrial empires had appeared. Politicians knew little about business growth, depressions, or economic theories. Democrats and Republicans favored a policy of *laissez faire* (nonregulation), and the government left business largely in the hands of businessmen. Neither party seemed aware of hardships that industrialization brought to many people.

In 1893, shortly after Cleveland began his second term as president, a major economic depression struck the nation. Farmers cried out against high railroad charges to send their goods to market. Many city workers demanded jobs, and others called for higher wages. Confused by the problems of an increasingly industrialized society, Cleveland followed a laissez-faire policy at the same time that farmers faced ruin, city workers went on strike, and the unemployment rate went up.

As president, Cleveland stood for a national currency backed by gold. By the election of 1896, many Democrats favored government action to increase the money in circulation by allowing the free coinage of silver. They

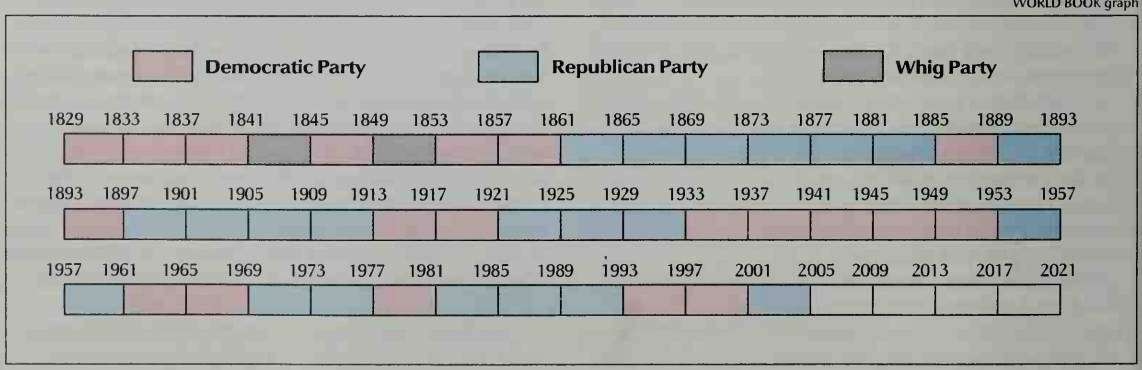
Democratic presidential and vice presidential candidates

Year	President	Vice President	Year	President	Vice President
1828	*Andrew Jackson*	*John Calhoun*	**1916**	*Woodrow Wilson*	*Thomas R. Marshall*
1832	*Andrew Jackson*	*Martin Van Buren*	**1920**	James M. Cox	Franklin D. Roosevelt
1836	*Martin Van Buren*	*Richard M. Johnson*	**1924**	John W. Davis	Charles W. Bryan
1840	Martin Van Buren	Richard M. Johnson	**1928**	Alfred E. Smith	Joseph T. Robinson
1844	*James K. Polk*	*George M. Dallas*	**1932**	*Franklin D. Roosevelt*	*John Nance Garner*
1848	Lewis Cass	William O. Butler	**1936**	*Franklin D. Roosevelt*	*John Nance Garner*
1852	*Franklin Pierce*	*William R. D. King*	**1940**	*Franklin D. Roosevelt*	*Henry A. Wallace*
1856	*James Buchanan*	*John C. Breckinridge*	**1944**	*Franklin D. Roosevelt*	*Harry S. Truman*
1860	Stephen A. Douglas	Herschel V. Johnson	**1948**	*Harry S. Truman*	*Alben W. Barkley*
1864	George B. McClellan	George H. Pendleton	**1952**	Adlai E. Stevenson	John J. Sparkman
1868	Horatio Seymour	Francis P. Blair, Jr.	**1956**	Adlai E. Stevenson	Estes Kefauver
1872	Horace Greeley	B. Gratz Brown	**1960**	*John F. Kennedy*	*Lyndon B. Johnson*
1876	Samuel J. Tilden	Thomas A. Hendricks	**1964**	*Lyndon B. Johnson*	*Hubert H. Humphrey*
1880	Winfield S. Hancock	William H. English	**1968**	Hubert H. Humphrey	Edmund S. Muskie
1884	*Grover Cleveland*	*Thomas A. Hendricks*	**1972**	George S. McGovern	Sargent Shriver
1888	Grover Cleveland	Allen G. Thurman	**1976**	*Jimmy Carter*	*Walter F. Mondale*
1892	*Grover Cleveland*	*Adlai E. Stevenson*	**1980**	Jimmy Carter	Walter F. Mondale
1896	William Jennings Bryan	Arthur Sewall	**1984**	Walter F. Mondale	Geraldine A. Ferraro
1900	William Jennings Bryan	Adlai E. Stevenson	**1988**	Michael S. Dukakis	Lloyd M. Bentsen, Jr.
1904	Alton B. Parker	Henry G. Davis	**1992**	*Bill Clinton*	*Al Gore*
1908	William Jennings Bryan	John W. Kern	**1996**	*Bill Clinton*	*Al Gore*
1912	*Woodrow Wilson*	*Thomas R. Marshall*	**2000**	Al Gore	Joseph I. Lieberman

Names of elected candidates are in italics. Each candidate has a biography in World Book.

Administrations in office

WORLD BOOK graph



believed that free coinage of silver would help solve the nation's economic problems. The money question became the major campaign issue. Most Democrats supported silver, but most Republicans favored gold.

In 1896, William Jennings Bryan won the Democratic presidential nomination with his famous "cross of gold" speech (see **Bryan, William Jennings**). He campaigned energetically and won wide support in the South and West—but ran poorly in the East and lost the election. Bryan lost again in 1900, and, after another Democratic defeat in 1904, he lost again in 1908.

Wilsonian democracy. In 1912, a split in the Republican Party enabled the Democratic candidate, Woodrow Wilson, to win the presidency (see **Roosevelt, Theodore** ["Bull Moose" candidate]). And, for the first time in 20 years, the Democrats gained control of both houses of Congress. Wilson won reelection in 1916, and the Democrats retained control of Congress.

Wilson wanted to eliminate monopoly and special privilege from American business, but without expanding the regulatory power of the federal government. He worked to restore fair competition and called for Americans to have a "new freedom" to prosper. During his first administration, he signed into law such reform legislation as the Clayton Antitrust Act, the Federal Trade Commission Act, and the Underwood Tariff Act.

During Wilson's second administration, World War I overshadowed his drive for reform legislation. Wilson directed the nation's energy to the defeat of Germany. After the war, he called for the United States to join the League of Nations. Wilson, the chief planner of the league, believed that the international organization would prevent future wars. Most Democrats supported the league, but some joined with conservative Republicans and blocked U.S. membership.

During the 1920's, the Democrats failed to win the presidency or to gain control of either house in Congress. The United States seemed prosperous. Business boomed, and industries expanded. But beneath the surface of prosperity lay much economic disorder. Neither business nor government took action in spite of danger signals occurring in 1927 and 1928.

In 1929, the worst business crash in United States history brought some government action. But the Republican administration of Herbert Hoover would only go so far. It provided aid for some failing banks, railroads, and agricultural organizations during the Great Depression that followed in the 1930's. But Hoover was committed to the concept of "rugged individualism," and he rigidly refused to offer direct government aid to people in need of relief from the economic disaster.

The New Deal. The Great Depression brought a revolution in the fortunes of the Democratic Party. Democrats won every presidential election of the 1930's and 1940's and controlled Congress for most of that period. Franklin D. Roosevelt won the elections of 1932, 1936, 1940, and 1944 and became the only man to win the presidency four times. Vice President Harry S. Truman became president after Roosevelt's death in 1945 and won the election in 1948.

Roosevelt was the dominating figure of the years of the Great Depression. He did even more than Wilson to convert the Democrats from a party of states' rights and limited government to one of national reform. During the 1932 campaign, he had promised Americans a "new deal" that included economic relief, recovery, and reform and a better life for what he called the "forgotten man." Roosevelt's personality and confidence made him a hero to millions as he carried through promises of his New Deal program by greatly extending the role of government. Under the New Deal, the federal government imposed many business regulations and passed laws to help the needy. See **New Deal; Social security.**

United Press Int.

Franklin D. Roosevelt shakes hands with a coal miner—one of the "forgotten" men for whom he promised a "new deal" during his successful campaign for the presidency in 1932.

Most farmers, intellectuals, unemployed workers, wage earners, and members of minority groups supported the New Deal and voted Democratic. Most Southerners and residents of big cities also backed the party. But conservatives—both Democrats and Republicans—believed that the federal government was taking far too great a role in people's lives. Conservatives' opposition to Roosevelt's 1937 plan to "pack" the U.S. Supreme Court with new members led many Southern Democrats to join Republicans in a conservative coalition (see **Roosevelt, Franklin D.** [The Supreme Court]). Until the 1960's, this coalition frequently blocked Democratic presidents' attempts at reform. During World War II (1939-1945), Roosevelt turned the nation's efforts toward defeating Germany and Japan.

The Fair Deal. President Truman continued the policies of the New Deal, calling his program the Fair Deal. He fought for civil rights for African Americans and for a national medical insurance plan. Southern Democrats often joined Republicans to block Truman's efforts.

In 1948, some Southern Democrats formed the States' Rights Democratic Party, or Dixiecrat Party, to oppose Truman. But Truman won a surprise victory over the Republican candidate, Thomas E. Dewey.

In both 1952 and 1956, the Democratic presidential candidate, Adlai E. Stevenson, lost to Dwight D. Eisenhower, one of the nation's greatest heroes of World War II. Yet the Democrats controlled Congress for the last six of Eisenhower's eight years in office.

The New Frontier. John F. Kennedy won the presidency in 1960, defeating Republican Richard M. Nixon. Kennedy called for many reforms in his program, which he named the New Frontier. Democrats outnumbered Republicans in both houses of Congress, but conserva-

tive Southern Democrats frequently joined conservative Republicans to defeat bills supported by Kennedy.

The Great Society. Vice President Lyndon B. Johnson became president after Kennedy was assassinated in November 1963. In 1964, Johnson won a full term as president with a landslide victory over his Republican opponent, Barry M. Goldwater. Johnson worked hard for the program begun by Kennedy. He called on the nation to join him in building what he termed the Great Society. Congress approved Johnson's requests for aid to cities and education, landmark civil rights legislation, greater Social Security benefits, and tax cuts.

Times of trouble. By 1966, the Vietnam War—and the nationwide dispute about it—overshadowed Johnson's Great Society program. The war divided many Americans into "hawks," who supported U.S. involvement in Vietnam, and "doves," who opposed it.

In 1968, Johnson announced that he would not run for reelection. The Democrats nominated Vice President Hubert H. Humphrey for the presidency. George C. Wallace, a Southern Democrat, became the candidate of a third party, the American Independent Party. The Republican candidate, Richard M. Nixon, won in 1968, but the Democrats kept control of Congress.

In 1969, a commission chaired by Senator George S. McGovern of South Dakota adopted a set of rules for the states to follow in selecting convention delegates. These rules reduced the influence of party leaders on the nominating process and provided greater representation for minorities, women, and youth. The reforms led most states to adopt laws requiring primary elections, instead of party leaders, to choose delegates.

In 1972, the Democrats nominated McGovern, and the Republicans renominated Nixon. Nixon won a landslide victory. In 1974, he resigned rather than face impeachment for the Watergate scandal (see **Watergate**). Vice President Gerald R. Ford succeeded him.

Mixed results. Jimmy Carter, the Democratic nominee, defeated Ford in the 1976 presidential election. The Democrats also retained control of Congress. In the 1980 election, however, Carter lost his bid for a second term. He was defeated by former Governor Ronald Reagan of California, the Republican candidate. The Democrats also lost the Senate to the Republicans, though they kept control of the House.

AP/Wide World

The 1984 Democratic candidates waved as they left a rally. Geraldine A. Ferraro was the first woman vice presidential candidate of a major political party. She ran with Walter F. Mondale.

Walter F. Mondale, Carter's vice president, became the Democratic presidential nominee in 1984. His running mate, Representative Geraldine A. Ferraro of New York, was the first woman vice presidential candidate of a major American political party. However, Reagan easily won a second term as president, and the Republicans retained control of the Senate. But the elections of 1986 gave the Democrats control of both houses of Congress.

In 1988, Massachusetts Governor Michael S. Dukakis won the Democratic presidential nomination. He lost the election to Republican Vice President George H. W. Bush, but the Democrats retained control of Congress.

In 1992, Governor Bill Clinton of Arkansas, the Democratic candidate, defeated Bush and independent candidate Ross Perot in the presidential election. In 1994, the Democrats lost control of both houses of Congress to the Republicans. In 1996, Clinton was reelected president, defeating Republican Robert Dole. But the Republicans retained control of both houses of Congress in 1996 and 1998.

Vice President Al Gore was the Democratic candidate in 2000. His running mate, Connecticut Senator Joseph I. Lieberman, was the first Jewish vice presidential candidate of a major American political party. Gore lost a close race to his Republican opponent, Texas Governor George W. Bush. The Republicans kept control of the House. The Senate was evenly divided. But in 2001, Vermont Senator James Jeffords left the Republican Party and became an independent. As a result, the Democrats gained control of the Senate.

Sidney M. Milkis

Related articles in *World Book* include:

Dixiecrat Party	Political convention	President of the United States
Great Society	Political party	United States, History of the
Liberty League		

Additional resources

Kurian, George T., ed. *The Encyclopedia of the Democratic Party.* 2 vols. M. E. Sharpe, 1997.

Rutland, Robert A. *The Democrats: From Jefferson to Clinton.* Rev. ed. Univ. of Mo. Pr., 1995.

Democratic-Republican Party was a political party established during the 1790's under the leadership of Thomas Jefferson and James Madison. It was generally called the Republican Party, but it had no relation to today's Republican Party, founded in 1854.

People from a variety of backgrounds formed the Democratic-Republican Party to oppose the policies of the Federalist Party, led by Alexander Hamilton. The Federalists wanted a strong national government controlled by the upper classes. The Democratic-Republicans favored a weak national government. They believed that all the people should take part in government.

Jefferson was president from 1801 to 1809. He reversed some Federalist policies that had been put into effect when Hamilton was secretary of the treasury. Madison succeeded Jefferson and served from 1809 to 1817. Another Democratic-Republican, James Monroe, held the presidency from 1817 to 1825.

By about 1816, the Federalist Party had broken up as a national organization. With its decline, the Democratic-

Republican Party split into several groups. Andrew Jackson emerged as the candidate of one of these groups and was elected President in 1828. Most historians regard Jackson's campaign organization as the beginning of today's Democratic Party. The Democratic Party itself traces its origin to Jefferson's Democratic-Republican Party. William Nisbet Chambers

Democritus, *dih MAHK rih tuhs* (460?-370? B.C.), was a Greek philosopher. He argued that the world consisted of an infinite number of atoms moving in an infinite void. These atoms are invisible and indivisible particles of matter that were ungenerated and indestructible. They differ from one another in size, shape, and position. Each thing in the world is a different combination of these atoms. Our world came about as the chance combination of atoms, and since there are an infinite number of atoms, innumerable other worlds also have come to be.

Democritus believed all sensation is a form of touch resulting from atoms colliding with the sense organs. But the senses do not provide true knowledge of reality. He reasoned that the senses reveal a world of colors, smells, and tastes while, in reality, only atoms and the void exist. True knowledge—that of the atoms and the void—comes from the intellect, not the senses.

Democritus was born in Abdera in northern Greece. He wrote on ethics, physics, mathematics, literature, and language, but only fragments of his works survive. We know of his theory of atomism through the testimony of other ancient authors. Carl A. Huffman

See also **Atomism; Pre-Socratic philosophy; Materialism.**

Demography, *dih MAHG ruh fee,* is the study of human populations. *Demographers* (population experts) study such characteristics as age, number, distribution, and sex of people in an area. This information comes from a population census or national sample survey. Most nations conduct censuses, usually once every 10 years. Demographers also study population change, which is the result of births, deaths, movement of people, and changes in population characteristics.

People in government, business, and other fields use demographic methods to study aspects of a society or economy. Businesses want to know such *demographics* (demographic data) as the age, sex, income level, life style, location, and consumer habits of people in potential markets for their products. Karl E. Taeuber

See also **Census; Population; Sociology** (Population characteristics); **Vital statistics.**

DeMolay, *DEE moh LAY,* **Order of,** is an international organization of young men between the ages of 13 and 21. The purpose of the organization is to provide a supportive environment that helps young men grow into responsible, caring adults. Members engage in activities that develop leadership and social skills, civic awareness, and responsibility. Since its founding in 1919, the Order of DeMolay has initiated more than 1 million members. It has more than 1,500 local chapters in the United States and eight other countries.

The Order of DeMolay was founded in Kansas City in 1919 by Frank S. Land. Land asked a boy named Louis Lower to invite some of his friends to a meeting to discuss forming a club. The boys chose Jacques de Molay (1243?-1314) as the club's namesake. Jacques de Molay was the last Grand Master of the Knights Templars, a famous group of French crusaders.

The philosophy of the organization is based on seven virtues: filial love, reverence for God and respect for others, courtesy, comradeship, fidelity, cleanness, and patriotism. The Order of DeMolay has international headquarters located in Kansas City, Mo.

Critically reviewed by the Order of DeMolay

Demon. See **Devil; Devil worship.**

Demosthenes, *dih MAHS thuh neez* (384?-322 B.C.), was an Athenian statesman who is usually considered the greatest Greek orator. He is best known for his *Philippics,* a series of speeches that attacked King Philip II of Macedonia as a threat to Greek independence. Today, the term *philippic* means *a bitter attack in words.*

Demosthenes was the son of a wealthy Athenian. His father died when he was a boy, and Demosthenes was raised by three guardians. The guardians stole most of his inheritance. But Demosthenes studied law and oratory, and this training helped him when he brought his guardians to court after he reached adulthood. His lawsuit against them went so well that he entered politics.

Demosthenes overcame great difficulties to become an orator. He had a harsh, unpleasant voice and an awkward manner, and he suffered from shortness of breath. According to legend, he learned to speak properly by shouting above the roar of ocean waves with his mouth full of pebbles.

Demosthenes was one of the first people to recognize the ambition of Philip II to take over Greece. He urged the Athenians to pay the taxes needed to strengthen their army and navy, and to serve in the armed forces themselves instead of relying on hired soldiers. He was only partially successful in rousing the Athenians to resist Philip's growing power in Greece.

Philip gained control of Delphi, in central Greece, by 346 B.C. At that time, Greece was divided into independent *city-states,* each of which consisted of a city and its surrounding territory. Demosthenes urged the city-states to join forces to oppose Philip. He eventually persuaded the powerful city-states of Athens and Thebes to form an alliance.

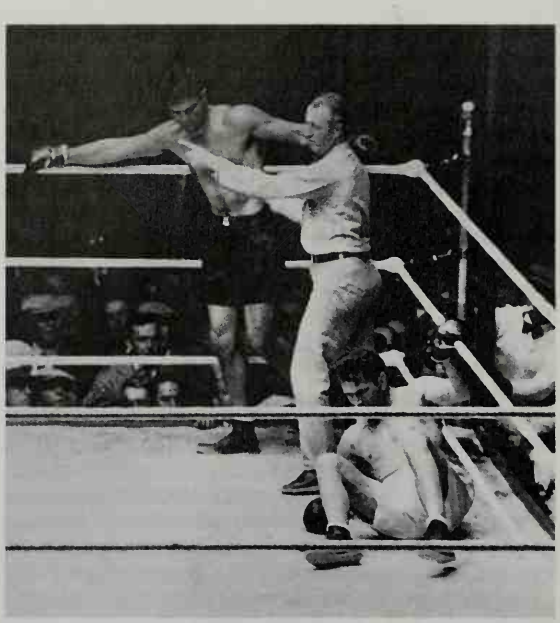
Philip defeated the armies of Athens and Thebes at the Battle of Chaeronea, near present-day Levadhia, in 338 B.C. Athens made peace, but Demosthenes continued to oppose Macedonian rule. He defended his policy with his oration "On the Crown," which many experts consider the most nearly perfect speech in history.

In 323 B.C., Demosthenes rallied the Greeks for another attack on Macedonia. But the attack failed, and he poisoned himself to avoid capture. Donald Kagan

See also **Philip II.**

Demotic. See **Hieroglyphics; Greek language** (Modern Greek).

Dempsey, Jack (1895-1983), became one of the most popular heavyweight boxing champions of all time. He was also one of the most fearsome with over 25 first-round knockouts, more than any fighter in history. He knocked out Jess Willard in 1919 to win the title. Dempsey lost the title in 1926 to Gene Tunney. Their second fight, in Chicago in 1927, featured the famous "long count." Dempsey knocked Tunney down in the seventh round. But he did not go to a neutral corner immediately, so referee Dave Barry delayed starting the count



United Press Int.

Jack Dempsey knocked down defending heavyweight champion Gene Tunney in the famous "long count" fight in 1927.

over Tunney. Tunney rose at the count of 9, but observers estimated this was equal to a count of 14. Tunney went on to win the fight by a 10-round decision.

William Harrison Dempsey was born in Manassa, Colorado. He started fighting professionally in 1914. Dempsey was nicknamed the *Manassa Mauler* by sports journalist Damon Runyon. Dempsey discussed his boxing career in his autobiography, *Dempsey* (1977).

Bert Randolph Sugar

See also **Boxing** (picture); **Tunney, Gene.**

Dempster, Arthur Jeffrey (1886-1950), was an American physicist. In 1935, Dempster discovered uranium 235 (U-235), a rare *isotope* (form) of the element uranium. This uranium isotope is a key substance in the atomic bomb.

Dempster was one of the developers of the *mass spectrograph,* an instrument for sorting out atoms by their mass. Using this instrument, he discovered many isotopes and obtained highly accurate measurements of their masses. Such information is essential for measuring transformations of mass and energy. Dempster also made important contributions to the development of the atomic bomb during World War II (1939-1945).

Dempster was born in Toronto, Ontario, and graduated from the University of Toronto. He moved to the United States in 1914, and he became a United States citizen in 1918. In 1916, Dempster took his doctor of philosophy degree at the University of Chicago. He taught physics there from 1919 until his death. Daniel J. Kevles

See also **Isotope; Uranium.**

Demuth, Charles (1883-1935), an American painter, is best known for his still lifes and flower pieces, principally executed in water colors. He achieved early recognition for his water colors that illustrated stories by Henry James and other authors. Demuth also used the medium in lively representations of vaudeville performances and unconventional lifestyles in New York City in the 1910's. About 1917, Demuth began to combine new Cubist influences with recognizable subject matter, often involving architectural or nautical themes. His later work became more geometric and precise in form, but it rarely was abstract. In these paintings, Demuth began to experiment with tempera and oil paints. An example, *My Egypt,* appears in the **Painting** article. He was born in Lancaster, Pennsylvania. Charles C. Eldredge

Den, in scouting. See **Boy Scouts** (Cub Scouting).

Denali National Park, *duh NAHL ee,* protects the herds of wild animals that roam in one of the finest wildlife regions in North America. The park is in south-central Alaska, about 120 miles (193 kilometers) southwest of Fairbanks. For the park's area, see **National Park System** (table: National parks).

The park was established in 1917 as Mount McKinley National Park. It received its present name in 1980. Mount McKinley, in the southwestern end of the park, is the chief attraction. It is the highest peak in North America and towers to 20,320 feet (6,194 meters). Its Indian name is *Denali,* meaning *The Great One* or *The High One.* Mount Foraker, near McKinley, rises 17,400 feet (5,304 meters). Over 300 other peaks of the Alaska Range rise along the park's southern border.

About 30 kinds of animals live in this rich wildlife region. There are grizzly bears, moose, caribou, Dall's sheep, red and silver foxes, squirrels, and rabbits. More than 80 kinds of birds nest in the park. Birds in the park include the Alaska jay, golden eagle, golden plover, jaeger, raven, robin, surfbird, wandering tattler, and white-crowned sparrow. The park is open the year around. It may be reached by rail, highway, or air.

Critically reviewed by the National Park Service

See also **Mount McKinley.**

Denarius, *dih NAIR ee uhs,* was a silver coin used by the Romans during the periods of the Republic and the Empire. The Romans first issued the coins about 211 B.C. The denarius disappeared from circulation in the A.D. 200's. The silver denarius by that time had been replaced by one struck from *billon,* an alloy made with copper and a small amount of silver. The value of the denarius first equaled 10, and later 16, of the copper coins called *asses.* The standard gold coin of the Roman Empire was the *aureus.* It was about the same size as the denarius and was worth 25 denarii.

The denarius was the penny referred to in the New Testament. Its initial, *d,* was the English symbol for penny, or pence. R. G. Doty

See also **Coin collecting** (picture).

Deneb, *DEHN ehb,* is the brightest star in the constellation Cygnus, or the Swan. Deneb is also called *Alpha Cygni.* It is one of the most brilliant stars visible to the unaided eye, having an apparent magnitude of 1.26 (see **Magnitude**). Deneb is 60,000 times as bright as the sun, but it appears faint because it is about 1,600 light-years away (see **Light-year**). Deneb appears bluish-white due to its extremely high surface temperature of at least 18,000 °F (10,000 °C). Astronomers classify the star as a *blue supergiant* because of its color and enormous size. Deneb's diameter is about 100 times that of the sun.

Sumner Starrfield

See also **Astronomy** (map: The stars and constellations of the Northern Hemisphere).

Deng Xiaoping, *duhng shyow pihng* (1904-1997), also spelled *Teng Hsiao-p'ing,* was China's most influential leader from the late 1970's, following the death of Mao Zedong, to the early 1990's. Even though Deng resigned from his last remaining Communist Party and government posts in 1989, he was still referred to as China's "paramount leader." Top party and government officials continued to consult Deng on all important issues and decisions. Deng's influence enabled him to bring about major changes in China.

His leadership. Mao Zedong, who had been China's top leader, died in 1976. Deng then became the moving force behind cultural, economic, and political changes that began to occur in China. These changes were a response to the radical Communist policies of Mao. Under Deng, cultural contacts and trade between China and other countries increased. Deng also decreased the Communist Party's regulation of business activity.

As a result of Deng's economic changes, China's economy grew and living conditions improved. However, the changes led to inflation and created more social inequality. Some of China's Communist Party leaders opposed Deng's policies, threatening the unity of the party.

AP/Wide World

Deng Xiaoping

Although Deng's policies brought some political openness to Chinese society, many citizens called for a greater degree of democracy. In 1989, large numbers of people, especially students, demonstrated for more democracy. The military killed many of the demonstrators. Deng backed a strong response against the demonstrators. This position earned Deng hostility in China and abroad. But the hostility did not diminish his power. In 1992, Deng advocated further opening to the outside world.

Deng used ideas from both Communism and other systems of government to modernize China's economy. In 1962, Deng demonstrated his political flexibility by his statement: "It does not matter whether a cat is black or white so long as it catches mice."

His life. Deng was born Deng Xixian in the province of Sichuan, also called Szechwan, into a family of landowners. He became active in revolutionary activities while working and studying in France during the early 1920's. He joined the Chinese Communist Party in 1924.

In 1927, fighting began between the Chinese Communists and the ruling Nationalists. Deng commanded Communist soldiers against Nationalists. The Communists won control of China in 1949. Deng had been elected to the Central Committee of the Communist Party in 1945. In 1955, he became a member of the party's Politburo—China's chief policymaking body. In 1956, he was appointed general secretary of the Communist Party—then one of the highest posts.

In the early 1960's, Deng came into conflict with party leader Mao Zedong over the amount of control the Communist Party should have in China. Deng believed that Mao's strict allegiance to Communist principles had damaged the economy. Deng and many others who opposed Mao lost power during China's Cultural Revolution (see **China** [The Cultural Revolution]). Deng returned to politics in 1973, only to be deposed again in early 1976. After Mao's death in September 1976, Deng gradually emerged as the top leader in China. Arif Dirlik

Dengue, *DEHNG gay,* also called *breakbone fever,* is a disease that causes fever, headaches and eye aches, and pain in the muscles and joints. It may also cause a runny nose, sore throat, and skin rash. Dengue is caused by four viruses carried by mosquitoes. Symptoms appear three to six days after a disease-bearing mosquito bites the victim. The rash breaks out on the fifth day of the illness. The fever subsides and then usually rises again.

Dengue is found in the tropics and subtropics. It is seldom fatal but can cause a fatal illness—called *dengue hemorrhagic fever*—chiefly in children. In severe cases, patients experience *shock syndrome* (very low blood pressure and a weak pulse). Dengue hemorrhagic fever with shock syndrome is widespread in Southeast Asia. The illness occurs primarily in children who have had a previous dengue infection. Thomas P. Monath

See also **Virus.**

Denim is a sturdy fabric made from cotton, synthetic fibers, or a blend of both. The cloth is woven in the *twill weave* pattern. Denim was first woven in Nîmes, France, about A.D. 300 and was called *serge de Nîmes.* In the mid-1800's, the American clothing manufacturer Levi Strauss produced the first blue denim jeans. See also **Jeans; Strauss, Levi; Twill.** Phyllis Tortora

De Niro, *duh NEER oh,* **Robert** (1943-), is an American motion-picture actor. He specializes in portraying characters who are neurotic, intense, and psychologically driven. De Niro received the 1980 Academy Award as best actor for his performance as boxer Jake LaMotta in *Raging Bull.* He won the 1974 Academy Award as best supporting actor for his portrayal of gangster boss Vito Corleone in *The Godfather, Part II.*

Many of De Niro's most famous performances have been in films directed by Martin Scorsese. These films include *Mean Streets* (1973), *Taxi Driver* (1976), *New York, New York* (1977), *Raging Bull, The King of Comedy* (1983), *GoodFellas* (1990), and *Casino* (1995).

De Niro's other important films include *The Deer Hunter* (1978), *Once Upon a Time in America* (1984), *The Untouchables* (1987), *Awakenings* (1990), *Cape Fear* (1991), *Mad Dog and Glory* (1993), *Wag the Dog* (1997), *Analyze This* (1999), *Meet the Parents* (2000), and *Men of Honor* (2000). In addition, De Niro directed and starred in *A Bronx Tale* (1993).

De Niro was born in New York City. At the age of about 16, he began to study under the distinguished acting teachers Lee Strasberg and Stella Adler. De Niro appeared in several plays in New York City before making his motion-picture debut in *Greetings* (1968).

Louis Giannetti

See also **Scorsese, Martin.**

Paramount Pictures Corporation

Robert De Niro

© Travelpix from FPG

Denmark's charm and prosperity are evident in the well-maintained old buildings and fashionable cafes of Copenhagen's Nyhavn Canal. Copenhagen is the capital and largest city of Denmark, as well as the country's cultural, economic, and political center.

Denmark

Denmark is a small kingdom in northern Europe that is almost surrounded by water. It consists of a peninsula and 482 nearby islands. The peninsula, called Jutland, shares a 42-mile (68-kilometer) border with Germany. Greenland, off the northeastern coast of Canada, is a province of Denmark even though it lies 1,300 miles (2,090 kilometers) away. The Faroe Islands, north of Scotland, are a self-governing part of the Danish kingdom. Denmark, along with Norway and Sweden, is one of the Scandinavian countries.

More than half of the Danes (people of Denmark) live on the islands near the peninsula. Copenhagen, the capital and largest city of Denmark, is on the largest island. About a fourth of all Danes live in the Copenhagen area, and almost half of the country's manufacturing industries are located there.

Denmark has one of the world's highest standards of living. The Danes have achieved prosperity even though their land is poor in natural resources. They sell their products to other countries to pay for the fuels and metals they must import for their industries.

Denmark is famous for its butter, cheese, bacon, ham, and other processed foods. The country is also known for its beautifully designed manufactured goods. These goods include furniture, porcelain, and silverware. Since the Viking era, the Danes have been a seafaring people, and Denmark is still known as a great shipping and fishing nation.

Denmark is a land of small green farms, blue lakes, and white coastal beaches. The carefully tended farmlands make up about three-fourths of the country. In the farm areas, the roofs of most houses are made of red or blue tiles, or are thatched. Storks, which the Danes believe bring good luck, build nests on some rooftops. Castles and windmills rise above the rolling landscape. Visitors can enjoy Denmark's charm even in the busy, modern cities, with their well-preserved sections of colorful old buildings and cobblestone streets.

M. Donald Hancock, the contributor of this article, is Professor of Political Science and Director of the Center for European Studies at Vanderbilt University.

Government

National government. Denmark is a constitutional monarchy with a king or queen, a prime minister and

Facts in brief

Capital: Copenhagen.
Official language: Danish.
Official name: *Kongeriget Danmark* (Kingdom of Denmark).
Area: 16,639 mi² (43,094 km²). *Greatest distances*—east-west, 250 mi (402 km); north-south, 225 mi (362 km). *Coastline*—1,057 mi (1,701 km).
Elevation: *Highest*—Yding Skovhoj, 568 ft (173 m) above sea level. *Lowest*—sea level along the coasts.
Population: *Estimated 2002 population*—5,307,000; density, 319 per mi² (123 persons per km²); distribution, 85 percent urban, 15 percent rural. *1991 census*—5,146,469.
Chief products: *Agriculture*—barley, beef and dairy cattle, eggs, hogs, milk, potatoes, poultry, sugar beets, wheat. *Fishing*—cod, sand lances, trout. *Manufacturing*—bacon, butter, cheese, diesel engines, electrical and electronic equipment, furniture, ham, machinery, porcelain, ships, silverware.
National holiday: Constitution Day, June 5.
National anthems: "Kong Christian stod ved hojen mast" ("King Christian Stood by Lofty Mast") and "Der er et yndigt land" ("There Is a Lovely Land").
Money: *Basic unit*—krone. One hundred øre equal one krone.

© Thomas Nebbia, Woodfin Camp, Inc.

Christiansborg Palace is the home of Denmark's parliament, the Folketing. It also houses the Supreme Court and the Queen's Audience Chambers, where formal functions are held.

cabinet, and a parliament. The government is based on the Danish Constitution of 1953, which divides the government into three branches—executive, legislative, and judicial. The monarch serves as head of state but has little real power.

The monarch appoints the prime minister of Denmark. The prime minister must have the support of a majority of the members of the Danish parliament. If one political party controls a clear parliamentary majority, the leader of that party normally becomes the prime minister. However, the large number of parties in Denmark makes it almost impossible for any single party to win a majority. If no party has a majority, the person who can gain the support of the strongest *coalition* (combination of parties) becomes the prime minister. A prime minister who receives a vote of no confidence from the parliament must either (1) resign, along with the rest of the cabinet; or (2) ask the monarch to dissolve the parliament and call a national election.

The prime minister heads the cabinet. The cabinet consists of a variable number of ministers, each of whom normally heads a government department. The monarch selects the members of the cabinet based on the prime minister's recommendations. The main executive powers are exercised by the cabinet in the monarch's name. However, the cabinet remains in power only as long as it has the support of a majority of the members of parliament.

Other high officials in Denmark, including judges, are named by the monarch on the advice of the cabinet. The parliament appoints an official called an *ombudsman,* who investigates citizens' complaints against actions or decisions by the government (see **Ombudsman**).

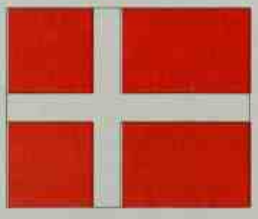
The Danish parliament, called the Folketing, consists of one house. It has 179 members, who are elected to four-year terms. One hundred seventy-five are elected from Denmark, 2 from Greenland, and 2 from the Faroe Islands. Of the seats from Denmark, 135 are filled by elections in voting districts, and 40 are divided among the various political parties according to their share of the total votes in the election. All Danish citizens at least 18 years old may vote.

Members of the Folketing discuss and vote on proposed legislation. Certain kinds of bills passed by the Folketing are subject to approval by the Danish voters. The people of Denmark also must be given the opportunity to vote on a bill if one-third of the Folketing's members call for such action.

Courts. Denmark's highest court is the Supreme Court. It consists of 15 judges, at least 5 of whom must hear each case. There are also two High Courts, with a total of about 50 judges. At least 3 High Court judges and a jury of 12 persons hear serious criminal cases. A jury verdict of innocent is final, but the judges may reverse a verdict of guilty. The judges and jurors act together to set the length of prison sentences. There are more than 100 lower courts.

Local government. Denmark is divided into 14 counties and 2 large municipalities—Copenhagen and Frederiksberg. The 14 counties are subdivided into almost 300 smaller municipalities. In most cases, a municipality consists of an urban center and a rural area. Each county and municipality in Denmark has a council elected by the people. Each council selects a mayor to head the local government.

Politics. Denmark has many political parties. The leading parties include the Conservative People's Party, the Liberal Party, and the Social Democratic Party. The



The Danish flag was probably first used in the 1200's, after King Valdemar II led a military crusade to Estonia.

H. E. Harris & Co.

Denmark's coat of arms dates from the 1100's. The lions of the Valdemar arms stand among water lilies.

WORLD BOOK map

Denmark is a small country in northern Europe. It consists of the peninsula of Jutland and hundreds of nearby islands.

Denmark map index

Counties

Århus	517,075	C	3
Bornholm	32,909	G	7
Frederiksborg	311,985	D	5
Fyn	375,071	F	3
København	603,179	E	6
Nordjylland	391,024	B	3
Ribe	175,968	E	1
Ringkøbing	208,430	D	1
Roskilde	197,676	E	5
Sønderjylland	193,607	F	2
Storstrøm	181,865	G	5
Vejle	273,107	E	2
Vestsjælland	209,159	E	4
Viborg	160,937	C	2

Cities

Åbenrå	15,799	F	2
Ålborg	114,970	B	3
Århus	204,139	D	3
Ballerup*	45,476	E	6
Birkenrød*‡	20,641	E	6
Brøndby*‡	33,794	E	6
Brønderslev	11,314	A	3
Copenhagen (København)*	464,566		
	†1,339,395	E	6
Dragør*	12,365	E	6
Dronninglund	2,905	B	3
Ebeltoft	4,121	D	4
Egtved	1,895	E	2
Esbjerg	72,205	E	1
Fåborg	7,235	F	3
Farum*	17,075	E	6
Fredensborg-Humlebæk*‡	18,732	D	6
Fredericia	28,529	E	3
Frederiksberg*	86,372	E	6
Frederikshavn	24,930	A	4
Frederiksværk	11,375	D	5
Gentofte*‡	66,077	E	6
Gilleleje	4,838	D	5
Give	3,859	D	2
Gladsakse*‡	60,604	E	6
Glostrup*‡	19,923	E	6
Grenå	14,023	C	4
Greve*	45,952	E	5
Grinsted	9,161	E	2
Haderslev	20,329	F	2
Hanstholm	2,476	B	1
Haslev	9,950	F	5
Hedensted	4,402	E	3
Helsinge	6,246	D	5
Helsingør	43,302	D	6
Herlev*‡	26,875	E	6
Herning	28,919	D	2
Hillerød	25,488	D	6
Hirtshals	6,966	A	3
Hjørring	24,224	A	3
Hobro	10,138	C	3
Høje Tåstrup*‡	44,746	E	6
Holbæk	21,851	E	5
Holstebro	29,819	C	1
Horsens	47,085	D	3
Hørsholm*	23,171	D	6
Hvidovre*‡	48,754	E	6
Ikast	13,943	D	2
Ishøj*	20,753	E	6
Juelsminde	2,872	E	3
Kalundborg	15,304	E	4
Karlebo*‡	18,967	D	6
Kjellerup	4,008	D	2
Køge	31,801	E	5
Kolding	45,514	E	2
Korsør	14,659	F	4
Lemvig	7,281	C	1
Lyngby-Tårbæk*‡	49,612	E	6
Middelfart	12,429	E	3
Næstved	38,185	F	5
Nakskov	14,922	G	4
Nordborg	7,868	F	3
Nyborg	15,352	F	4
Nykøbing	19,127	G	5
Odder	9,478	D	3
Odense	140,886	E	3
Randers	55,358	C	3
Ribe	7,892	F	2
Ringkøbing	8,764	D	1
Ringsted	17,457	E	5
Rodovre*‡	35,336	E	6
Ronne	14,389	G	7
Roskilde	40,928	E	5
Sæby	8,424	A	3
Silkeborg	35,027	D	2
Skælskør	5,936	F	4
Skagen	11,248	A	4
Skanderborg	11,470	D	3
Skive	19,711	C	2
Slagelse	29,583	E	4
Søllerød*‡	30,609	E	6
Solrød*‡	19,060	E	5
Sønderborg	25,551	F	3
Sorø	6,454	E	5
Stege	3,822	E	5
Stenløse‡	11,904	E	5
Struer	11,344	C	1
Svendborg	26,525	F	4
Tårnby*‡	39,772	E	6
Thisted	12,677	B	1
Vallensdæk*‡	11,871	E	6
Værlose*‡	17,370	E	6
Varde	12,106	E	1
Vejen	8,250	E	2
Vejle	46,074	E	2
Viborg	29,867	C	2
Vojens	7,704	F	2
Vordingborg	8,660	F	5

*Population of municipality, which may include rural areas as well as the urban center.
†Population of metropolitan area, including suburbs.

‡Does not appear on map; key shows general location.
Source: 1992 official estimates.

Conservatives favor limited government involvement in the economy. The Liberals support the adoption of a modern general social security system. The Social Democrats support strong social welfare programs, full employment, and public ownership of the means of production.

A radical party called the Progress Party opposes immigration into Denmark and favors eliminating income taxes and most of the civil service. Other political parties include the Center Democrats, the Red-Green Alliance, the Socialist People's Party, and the Social Liberals.

Armed forces. A total of more than 30,000 people serve in Denmark's army, navy, and air force. Men from 20 to 25 years of age may be drafted for nine months' service in the armed forces.

People

Copenhagen, Denmark's capital, is also the country's largest city. About a fourth of all Danes live in Copenhagen or its suburbs. Three other cities in Denmark have populations of more than 100,000. These cities are, in order of size, Århus, Odense, and Ålborg.

Ancestry. The Danes make up more than 99 percent of Denmark's population. The Danes are closely related to the Norwegians and the Swedes. Denmark's only ethnic minority group consists of people of German ancestry. These people live in southern Jutland, along Denmark's border with Germany.

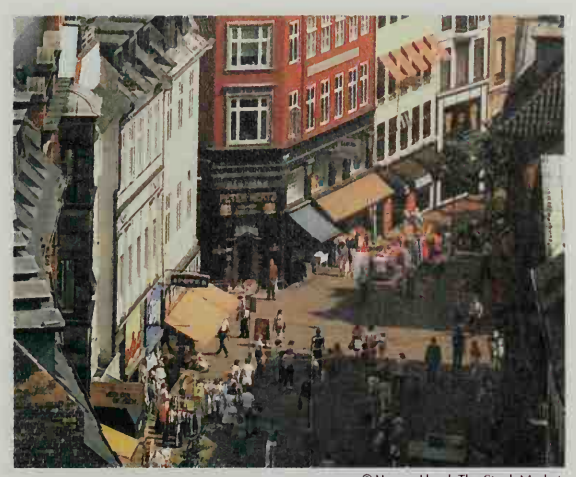
Language. Danish, the official language of Denmark, is closely related to the Norwegian and Swedish languages. Regional dialects abound and are especially noticeable in northern Jutland and on the island of Bornholm. German is spoken by the ethnic German minority. Virtually all adult Danes also speak English.

Way of life

City life. The principal cities of Copenhagen, Århus, Odense, and Ålborg feature a striking combination of medieval structures, such as castles and cathedrals, and modern office buildings and homes. Denmark's high standard of living and extensive social welfare services ensure that the cities have virtually no slums or substandard housing. Most city dwellers live in apartment buildings. Many suburban residents live in single-family houses. Service industries employ most people in urban areas.

Danish cities are served by an extensive network of public transportation. Modern trains whisk people from the suburbs to the city centers. Trains also link cities to one another. Bicycles, buses, and automobiles provide the chief means of transportation within the cities. The growth of the urban population and the resulting increase in the number of cars and trucks have led to problems of traffic congestion and pollution, especially in Copenhagen. Industrial pollution, however, has decreased, as many urban factories that once burned coal for power now rely on natural gas.

Rural life. Although cities dominate Denmark's economic and social life, the nation's many farms and rural villages show the continuing importance of agriculture. Danish farms are not large, and most are owned and operated by the people who live on them. Most of Denmark's rural residents live in modernized single-family homes.



© Harvey Lloyd, The Stock Market

Colorful shops and restaurants cluster in an area of Copenhagen called Strøget, which is closed to motor traffic.

Food and drink. Most Danes eat four meals a day—breakfast, lunch, dinner, and a late-evening supper. Breakfast generally consists of cereal, cheese, or eggs. Dinner, which includes fish or meat, is usually the only hot meal. A favorite traditional Danish dinner consists of roast duckling stuffed with apples and prunes, served with red cabbage and boiled potatoes.

The chief part of the other Danish meals consists of open-faced sandwiches called *smørrebrød*. One sandwich may be a pyramid-shaped pile of about 20 small shrimps on thin bread. The Danes often prepare a plate of smørrebrød almost as a work of art, with many attractive sandwiches.

Denmark is famous for rich, flaky raised sweet rolls that are often called *Danish pastries*. Danes especially enjoy a nut-filled coffeecake called *kringle*. Typical des-

© Elvig Hansen, Biofoto

Danish farmers use modern equipment, such as this harvesting combine. Most farms are family-owned and operated.

serts eaten by Danes include berry puddings and rice pudding.

The Danish people typically drink coffee with breakfast and during morning and afternoon breaks from work. Many Danes drink beer with meals. On special occasions, they also may drink *aquavit,* a strong liquor slightly flavored with caraway.

Religion. About 97 per cent of the Danish people belong to the Evangelical Lutheran Church, the official church of Denmark. The monarch is required by law to belong to the church, but the people have complete freedom to worship as they please. The church is supported largely by a national tax paid only by members. The Evangelical Lutheran Church has no supreme spiritual leader. Ten bishops manage church affairs. The Danish parliament has control of the church but does not interfere in its religious practices. Roman Catholics make up Denmark's second largest religious group.

Education. Almost all adult Danes can read and write. Danish law requires children to attend nine years of school. Elementary school consists of the first seven grades, and high school lasts from three to five years. A five-year high school education makes a student eligible to enter a university. Denmark has three universities. The University of Copenhagen is the oldest and largest. It was founded in 1479 and has about 24,000 students. The other universities are those of Århus and Odense.

The famous Danish folk high schools operate separately from the public educational system. They are private schools, but are supported largely by government funds. These schools provide young adults with a general education in Danish government, history, and literature. Courses last up to six months, and the students live at the schools. Denmark has about 20 folk high schools. The first ones were founded in the mid-1800's to help young farmers take a more active part in Denmark's political and social life. Today, the schools also attract many young adults of the cities and towns.

Libraries and museums. The chief libraries include the Royal Library in Copenhagen, founded in the mid-1600's. It is Denmark's national library, and has about 2 $\frac{1}{2}$ million books. Other leading libraries in Denmark include the University Library in Copenhagen, and the State and University Library in Århus. The Danish government supports a nationwide system of about 250 public libraries.

Denmark also has about 280 museums. Many important museums are located in Copenhagen. The National Museum houses exhibits that document Danish history from prehistoric through modern times. Fine paintings and sculptures by Danish and other European artists are on display in the State Museum of Art. The New Carlsberg Glyptotek features ancient Egyptian, Etruscan, Greek, and Roman art. The Louisiana Museum, south of Helsingør, is noted for its collection of modern art. The Viking Ship Museum in Roskilde houses five Viking ships dating from the A.D. 1000's.

Arts. Many Danes have won fame in the arts, especially in literature. Ludvig Holberg is known as the father of modern Danish literature. During the early 1700's, he wrote poems and plays that poked fun at Danish society (see **Holberg, Ludvig**). Johannes Ewald, who did much of his writing during the 1770's, became one of Denmark's greatest lyric poets.

Important literary works of the 1800's include the romantic poems of Adam Oehlenschläger and the hymns of N. F. S. Grundtvig. Hans Christian Andersen won world fame for his fairy tales and is probably Denmark's best-known writer (see **Andersen, Hans Christian**). The books of Søren Kierkegaard strongly influenced the development of the modern philosophy called *existentialism* (see **Kierkegaard, Søren**).

Henrik Pontoppidan and Johannes V. Jensen rank among the most important Danish novelists of the early 1900's. Each won the Nobel Prize for literature, as did Karl Gjellerup. Other noted Danish writers include Thorkild Bjørnvig, Isak Dinesen, Martin A. Hansen, and Martin Andersen Nexø. See **Dinesen, Isak.**

Carl A. Nielsen is considered Denmark's greatest musical composer. He wrote six symphonies and many other works, including the comic opera *Maskarade* (see **Nielsen, Carl A.**). In the field of dance, the ballet master August Bournonville made the most significant Danish contribution. The Royal Danish Ballet flowered under his direction during the mid-1800's, and today it enjoys a worldwide reputation.

Noted Danish painters include Michael Ancher, C. W. Eckersberg, Oluf Høst, Christen Købke, P. S. Krøyer, Theodor Philipsen, and William Scharff. Denmark's leading sculptor was Bertel Thorvaldsen. His statue of Christ in the Church of Our Lady in Copenhagen is one of his most famous sculptures (see **Thorvaldsen, Bertel**).

The Danish film director Carl Dreyer is regarded as a major figure in cinema history. His film *The Passion of Joan of Arc* (1928) is considered a masterpiece. In recent years, two Danish films have won the Academy Award for best foreign-language film: *Babette's Feast* (1987), directed by Gabriel Axel, and *Pelle the Conqueror* (1988), directed by Bille August.

Outstanding works of Danish design include the silverware of Georg Jensen and the furniture of Kaare Klint and Arne Jacobsen. As an architect, Jacobsen became known for his precise grouping of simple structural elements. Jørn Utzon designed the famous sail-like vaults of the Opera House in Sydney, Australia.

Recreation. Soccer is the most popular sport in Denmark. Other favorite sports include bicycling, gymnastics, rowing, sailing, swimming, and tennis. Danes have won Olympic and other world championships in most

© Shinichi Kammo, FPG

Tivoli Gardens is a world-famous amusement park in Copenhagen. Its exotic, lighted grounds attract many visitors at night.

of these sports, and also in archery, boxing, diving, fencing, riding, weightlifting, and wrestling.

Copenhagen is world famous for its Tivoli Gardens amusement park, which opened in 1843 in the heart of the city. The park offers ballet and pantomime, rides and shooting galleries, restaurants, circus acts, concerts, and fireworks displays.

Social welfare. Since the 1890's, Denmark has developed many social welfare programs. The country has social insurance plans that cover accidents, handicapping injuries, illness, old age, unemployment, and the death of husbands. Any person living in Denmark may join these programs. Most plans are managed by private, government-approved organizations, with costs shared by insured persons, employers, and the government. The government manages some plans, including aid for the aged and for widows, and pays the total cost.

The land

The peninsula of Jutland accounts for almost 70 per cent of the land in Denmark. However, most Danes live on about 100 nearby islands. The land is low throughout Denmark. The highest point, the hill of Yding Skovhøj on Jutland, rises only 568 feet (173 meters) above sea level. The land is covered mainly by *moraine,* the earth and stone deposited by melting glaciers thousands of years ago. The underlying rock can be seen in only a few areas.

Land regions. Denmark has five main land regions: (1) the Western Dune Coast, (2) the Western Sand Plains, (3) the East-Central Hills, (4) the Northern Flat Plains, and (5) Bornholm.

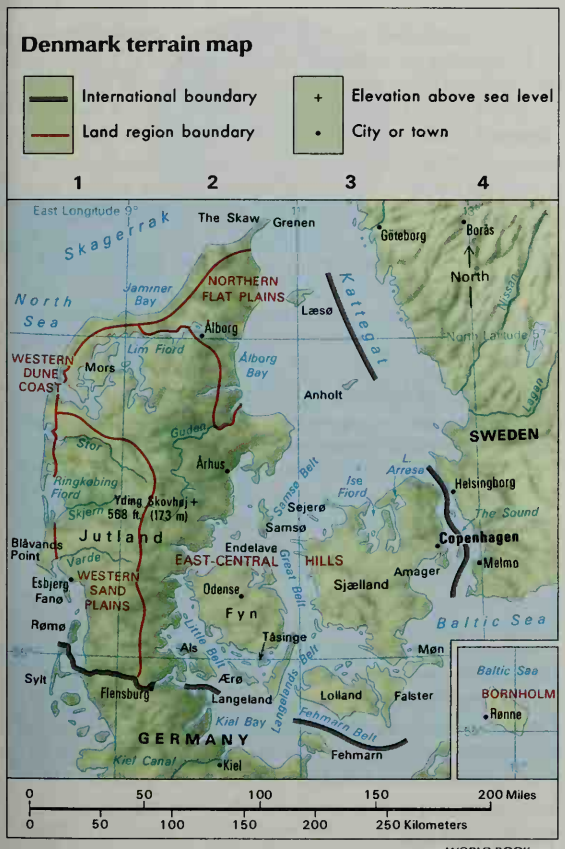
The Western Dune Coast consists chiefly of great sandy beaches that extend along almost the entire western coast. These beaches close off many long, narrow

Danish Tourist Board

The Western Dune Coast is an area of sandy beaches and dunes that extends along most of Jutland's western coast.

© Søren Koustrup, Biofoto

The East-Central Hills, covering much of Jutland and the nearby islands, have gently rolling lands and narrow fiords.



WORLD BOOK map

Physical features

Ålborg Bay ..... B 2
Als (island) ..... D 2
Baltic Sea ..... C 4
Bornholm (island) ..... D 4
Falster (island) ..... D 3
Fyn (island) ..... C 2
Great Belt (strait) ..... C 3
Guden River ..... B 2
Jutland (peninsula) ..... C 1
Kattegat (channel) ..... A 3
Lake Arresø ..... C 3
Langeland (island) ..... D 2
Langelands Belt (strait) ..... D 2
Lim Fiord ..... A 2
Little Belt (strait) ..... C 2
Lolland (island) ..... D 3
Samsø (island) ..... C 2
Sjælland (island) ..... C 3
Skagerrak (channel) ..... A 1
The Sound (Øresund) ..... C 4
Yding Skovhøj (hill) ..... C 2

inlets called *fiords* that once were connected to the sea. In the southwest are marshes that the tide covers regularly.

The Western Sand Plains are almost flat. Water from ancient melting glaciers flowed over this region and deposited much sand, forming the plains.

The East-Central Hills make up Denmark's largest land region. This gently rolling region includes much of Jutland and almost all the nearby islands. Long, narrow fiords form natural harbors along the coastlines of the region.

The largest inlet is Lim Fiord, which winds across northern Jutland for 112 miles (180 kilometers). This fiord forms an inland lagoon 15 miles (24 kilometers) wide. A beach on the Western Dune Coast closes off the fiord's outlet to the North Sea. Small vessels use the Thyborøn Canal to travel between Lim Fiord and the sea.

The islands in the region lie close together. Their deep moraine soils are the best farmlands in Denmark. The largest island, Sjælland, is 2,713 square miles (7,027 square kilometers). Sjælland is the most thickly populated part of Denmark. On this island stands most of Copenhagen, Denmark's capital and largest city. The rest of the city is on the island of Amager. Falster, Fyn, and Lolland are other important islands.

The Northern Flat Plains were once a part of the sea bottom. The region rose from the water when the weight of ancient glaciers was removed by melting. Many farms are in this region.

Bornholm and nearby small islands lie much closer to southern Sweden than to the rest of Denmark. Granite rock covers most of this region.

Lakes and rivers. Denmark has many small lakes. They formed in small hollows left in the ground by melting ice from the glaciers. Lake Arresø, the largest lake, covers 16 square miles (41 square kilometers). Denmark also has many short rivers. The longest one, Guden River, is 98 miles (158 kilometers) long.

Climate

Denmark has a mild, damp climate, chiefly because it is almost surrounded by water. In winter, seas are not so cold as land, and in summer they are not so warm. As a result, west winds from the seas warm Denmark in winter and cool it in summer. These winds affect Denmark's weather throughout the year. Also in winter, west winds bring some warmth from the North Atlantic Current of the Gulf Stream (see **Gulf Stream**). Denmark is small, so the climate does not differ much from area to area.

Winter temperatures average about 32 °F (0 °C) in Denmark, with the coldest days from 15 to 20 °F (−9 to −7 °C). The waters on the east may freeze over during especially cold winters. At these times, the waters cannot warm the cold winds and the weather may become bitterly cold. Summer temperatures average 63 °F (17 °C). The warmest weather usually varies from 75 to 82 °F (24 to 28 °C). Winds from eastern Europe may cause higher temperatures in especially hot summers.

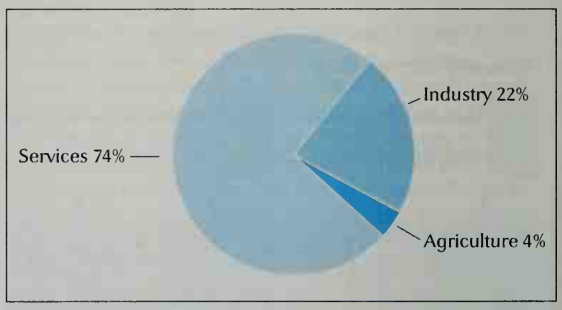
Denmark receives a yearly average of about 24 inches (61 centimeters) of *precipitation* (rain, melted snow, and other forms of moisture). Western Denmark gets a little more precipitation than eastern Denmark because the moisture-bearing west winds reach it first. Rain falls throughout the year, with the most during August and October. Snow falls from 20 to 30 days a year, but usually melts quickly. Fog and mist occur frequently, especially on the west coast in winter.

Economy

Denmark has a strong economy, even though the country is poor in natural resources. Denmark obtains some natural gas and petroleum from wells in the North Sea. But it still must import petroleum. Other products mined in Denmark include chalk and industrial clays. Coal, as well as iron and most other metals, must be imported. Much of the soil in Denmark lacks nutrients, so it requires heavy use of fertilizers to make it productive.

For hundreds of years, windmills have been prominent on the Danish landscape, turning grindstones and other farming devices. Now windmills generate almost a tenth of Denmark's electricity. The seas that almost surround the country provide an inexpensive means of

Denmark's gross domestic product



Denmark's gross domestic product (GDP) was $174,283,000,000 in 1999. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, government, and personal services; finance, insurance, real estate, and business services; trade, restaurants, and hotels; and transportation and communication. *Industry* includes construction, manufacturing, mining, and utilities. *Agriculture* includes agriculture, forestry, and fishing.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers: Number of people	Employed workers: Percent of total
Community, government, & personal services	26	950,700	35
Finance, insurance, real estate, & business services	24	307,100	11
Trade, restaurants, & hotels	16	439,000	16
Manufacturing	15	516,000	19
Transportation & communication	8	181,900	7
Construction	4	177,500	7
Agriculture, forestry, & fishing	4	96,600	4
Utilities	2	20,500	1
Mining	1	3,200	*
Total	100	2,692,500	100

*Less than one-half of 1 percent.
Figures are for 1999.
Sources: International Labour Office; International Monetary Fund.

transportation by which Denmark can import its industrial needs and export its products. The seas are also rich in fish.

Service industries employ more than two-thirds of the Danish labor force. Service industries are economic activities that produce services, not goods. They include schools, hospitals, shops, hotels, restaurants, and government services. Banking, real estate, transportation, and communication are also service industries.

Manufacturing in Denmark expanded rapidly in the last half of the 1900's and replaced agriculture as the nation's second largest economic activity. The government did much to promote manufacturing by expanding educational programs to train engineers, technicians, and skilled workers.

Nearly half of all Danish manufacturing is concentrated in the Copenhagen area. Danish factories produce high-quality goods, including stereos, television sets, furniture, porcelain, and silverware. Among Denmark's other products are diesel engines, machinery, pharmaceuticals, ships, textiles and clothing, and processed foods, which include bacon, butter, cheese, ham, and beer.

Agriculture. Farmland makes up about two-thirds of Denmark's total land area. Farms cover an average of about 100 acres (40 hectares). Until the 1880's, wheat was Denmark's most important farm product. Then wheat prices fell, and Danish farmers began to stress the production of eggs, hogs, and milk. They organized cooperative dairies and slaughterhouses, and shared equipment and profits. Today, cooperatives cover all branches of farming.

Raising hogs and beef or dairy cattle is the major activity on most Danish farms. Most crops are used for livestock feed. They include barley, potatoes, sugar beets, and *rape* (a leafy herb). Barley is grown on more of the nation's farmland than any other crop. About 60 percent of the country's farm production is exported as meat and dairy products.

Fishing. Danish fishing ships catch about 2 $\frac{1}{4}$ million tons (2 million metric tons) of fish each year. Important fish include cod, herring, Norway pout, sand lances, sprat, and whiting. Over half the catch is taken from the North Sea. Esbjerg is Denmark's major fishing port.

Transportation. Denmark has an excellent road system. Many roads have separate bicycle lanes because at least half of the people use bicycles for transportation. A government-owned railroad provides fast passenger service to most cities and towns.

Ferries, bridges, and underwater tunnels connect Danish islands with each other and with the mainland. The Storebaelt Bridge spans the Great Belt waterway between the islands of Fyn and Sjaelland. The Öresund Link is a bridge and tunnel connection between Copenhagen, Denmark and Malmö, Sweden. The link serves railroad trains as well as automobiles.

Denmark has many busy seaports, of which Copenhagen is the most important. Kastrup Airport, near Copenhagen, is one of Europe's largest air terminals. It handles about 12 million passengers a year.

Communication. Denmark has about 50 daily newspapers. The largest dailies include the *Berlingske Tidende, B.T., Ekstra Bladet,* and *Politiken,* all of Copenhagen.

Bang & Olufsen

Danish electronic products are known for their high quality and attractive design. This photograph shows a Danish factory worker assembling a television set.

Almost all Danish families own at least one radio and one television set. All radio and television broadcasting is handled by Radio Denmark, a public organization responsible to the Danish Ministry of Cultural Affairs. No advertising is allowed on the programs. The Danish people pay a yearly license fee for each radio and television set.

The government owns and operates the Danish telegraph system and long-distance telephone service. Most local telephone service is privately owned.

History

Early days. As long as 100,000 years ago, people lived in what is now Denmark. Great changes in the climate occurred, and the region became too cold for human life. The climate started to become warmer about 14,000 years ago, and continuous settlement began. Farming developed in the region about 3,000 B.C.

By the time of Christ, trade by sea had brought the people into close contact with leading civilizations. The contact expanded for hundreds of years. During this period, the Danes lived in small communities governed by local chieftains. In the mid-900's, all Denmark was united by King Harald Bluetooth. Harald fostered the spread of Christianity in Denmark.

About 800, Danish seafarers began raiding European coastal towns and sailing away with slaves and treasure. The Danish Vikings spread terror throughout much of western Europe for about 300 years. The Vikings gained control of England in 1016, and Danish kings ruled that country until 1042. See **Vikings** (The Danish Vikings).

A great power. During the late 1100's and early 1200's, Danish power expanded along most of the southern coast of the Baltic Sea. Denmark conquered northern Estonia in 1219. But a long period of civil wars and struggles with north German cities, beginning in the 1240's, greatly weakened the country.

Denmark regained its power under Queen Margaret, who became ruler of Denmark as regent for her young son in 1376. Margaret was also the wife of King Haakon VI of Norway. After he died in 1380, Margaret became regent of Norway as well as Denmark. In 1388, during

Roskilde Museum

A sculpture adorns the tomb of Queen Margaret, who united Denmark, Norway, and Sweden in the Union of Kalmar in 1397. Under her skillful leadership, Scandinavia enjoyed 20 years of peace and economic growth.

political confusion in Sweden, Swedish nobles elected her to rule that country, too. In 1397, Margaret united Denmark, Norway, and Sweden in the Union of Kalmar, with power centered in Denmark. Sweden broke away from the union in 1523.

In 1536, during the Reformation, King Christian III established Lutheranism as the official religion of Denmark. That same year, Christian made Norway a province of Denmark.

Wars with Sweden. During the 1600's and 1700's, Sweden defeated Denmark in several wars fought for control of the Baltic Sea. In the Danish-Swedish War (1657-1660), Sweden won a great deal of Danish and Norwegian territory in what is now Sweden. Only pressure from England, France, and the Netherlands prevented Sweden from dividing Denmark itself. In the Great Northern War (1700-1721), Denmark tried unsuccessfully to win back the territory it had lost to Sweden.

In 1788, Denmark began freeing its serfs. These peasants had been bound to the land on which they worked. Educational reforms were begun during the early 1800's. Denmark sided with France in the Napoleonic Wars of that period and was defeated by Sweden in 1813. By the terms of the Treaty of Kiel in 1814, Denmark gave Norway to Sweden but kept Greenland and other Norwegian colonies.

The Schleswig wars. In 1848, the pressure of public opinion forced King Frederik VII to accept a democratic constitution for Denmark. The constitution was adopted in 1849. It granted the highest power of government to an elected two-house parliament.

Also in 1848, a revolt broke out in Holstein and Schleswig, two Danish duchies located just south of Denmark. These regions were ruled by the Danish king, though they were not part of Denmark. A revolutionary government of Schleswig-Holstein was established. The government wanted to throw off Danish control and join the German Confederation. Holstein was already a member. Danish troops defeated the rebels in 1850. In 1863, Schleswig was made a part of Denmark. Prussia and its ally, Austria, invaded Denmark in 1864. They won a quick victory and took over Schleswig and Holstein.

Social and political reforms. During the late 1800's, education, industry, and trade were expanded in Denmark. The Danes also developed cooperatives and improved their farming methods. At this time, the upper classes had special rights that gave them control of the upper house of the parliament. The small farmers and industrial workers formed political parties and struggled for political equality. A new constitution was adopted in 1915 during the reign of Christian X, who was king from 1912 to 1947. By the terms of the constitution, the special rights of the upper classes were abolished, and Denmark became a parliamentary democracy.

Denmark remained neutral during World War I (1914-1918). After the war, Denmark granted independence to Iceland, a Danish colony. However, Iceland stayed united with Denmark until 1944, when it became a republic. In 1920, the Allies transferred North Schleswig to Denmark from Germany. Most people of the region had voted for the transfer.

World War II began in 1939. On April 9, 1940, German forces invaded Denmark, and the Danes surrendered after a few hours of fighting. The Germans allowed the Danish government to continue as long as it met their demands. But resistance groups developed and blew up factories and transportation facilities. The

Important dates in Denmark

c. 950 King Harald Bluetooth united Denmark and encouraged the spread of Christianity in the country.
1013-1042 Denmark ruled England.
1380 Denmark and Norway were united under Queen Margaret.
1388 Queen Margaret was elected ruler of Sweden as well.
1397 Denmark, Norway, and Sweden were united in the Union of Kalmar.
1536 Lutheranism became the official Danish religion.
1657-1660 Denmark lost much territory to Sweden in the Danish-Swedish War.
1788 The government began freeing the Danish serfs.
1814 Denmark lost Norway to Sweden in the Napoleonic Wars.
1849 Denmark adopted its first democratic constitution.
1864 Denmark lost Schleswig and Holstein to Prussia and Austria.
1918 Denmark granted independence to Iceland, which remained under the Danish king until 1944.
1920 North Schleswig was returned to Denmark.
1940-1945 Germany occupied Denmark during World War II.
1944 Iceland ended its union with Denmark.
1949 Denmark and 11 other nations formed the North Atlantic Treaty Organization (NATO).
1953 Denmark adopted a new constitution that ended the upper house of parliament.
1960 Denmark and other European countries formed the European Free Trade Association (EFTA).
1973 Denmark became a member of the European Community, an economic organization that later formed the basis of the European Union.
1982 A Conservative-led coalition government replaced the government of the Social Democrats, who had dominated the government for several decades.
1993 The Social Democrats regained government control.

Germans took over the Danish government in August 1943.

In September 1943, the Danes organized the secret Freedom Council to lead the resistance movement. They also helped about 7,000 Danish Jews escape to Sweden. On May 5, 1945, following the fall of Germany, Allied troops entered Denmark and the Germans there surrendered.

Denmark became a charter member of the United Nations in 1945 and of the North Atlantic Treaty Organization (NATO) in 1949. During the late 1940's, the United States gave Denmark much aid. The Danes rebuilt industries that had been damaged during the war, and the nation's economy became strong again.

Postwar years. Political reform and economic expansion in Denmark continued during the 1950's and 1960's. In 1953, a majority of Danish voters approved a new constitution that abolished the upper house of parliament. The constitution also made Greenland a province of Denmark, rather than a colony. In addition, Danish voters approved a law that permitted both males and females to inherit the throne.

In 1960, Denmark and six other European countries, including the United Kingdom, Norway, and Sweden, formed the European Free Trade Association (EFTA). EFTA regulates and promotes trade among its member countries (see **European Free Trade Association**). Denmark resigned from EFTA in 1972. In 1973, the country entered the European Community, an economic association of European nations.

In 1966, Denmark launched a massive economic development program in Greenland. The program called for the expansion and modernization of the towns and of the fishing and food-processing industries. In 1979, the Danish parliament granted *home rule*—that is, the power of local self-government—to Greenland.

King Frederik IX died in 1972. His oldest daughter, Margrethe, succeeded him to the throne.

Economic problems. During the 1970's and early 1980's, Denmark—like many countries—faced an economic recession. Economic growth slowed, and unemployment and inflation increased sharply. Several political parties gained support as many voters expressed their frustration over the economy.

In 1982, a Conservative-led coalition government replaced the government of the Social Democrats. The Social Democrats had held power either alone or as part of a coalition for most of the time since the end of World War II.

Recent developments. In 1993, Denmark and the other members of the European Community formed the European Union (EU) to increase economic and political cooperation among themselves. At that time, the European Community was incorporated into the EU.

A coalition led by the Social Democrats regained control of the government in 1993. The economy improved under the coalition, but Denmark still faced problems of environmental pollution, unemployment, and the high cost of welfare services.

In 2000, voters in Denmark rejected a proposal to adopt the euro, the EU's common currency. Many of them felt that closer ties to the EU would weaken both Denmark's economy and its national identity.

In parliamentary elections in 2001, the Liberal Party gained control of Denmark's government. The Liberal Party and their allies favor more conservative policies than the Social Democrats. M. Donald Hancock

Study aids

Related articles in *World Book* include:

Biographies

Andersen, Hans Christian
Bering, Vitus
Bohr, Niels
Brahe, Tycho
Bruhn, Erik
Canute
Christian IV
Christian IX
Christian X
Dinesen, Isak
Frederik
Holberg, Ludvig
Kierkegaard, Søren A.
Margrethe II
Nielsen, Carl A.
Oersted, Hans C.
Thorvaldsen, Bertel

History

Anglo-Saxons
Europe, Council of
European Union
Jutes
Norway (History)
Seven Weeks' War
Sweden (History)
Vikings
World War II

Physical features

Baltic Sea
Faroe Islands
North Sea
Skagerrak

Other related articles

Århus
Copenhagen
Greenland
Iceland
Scandinavia
Theater (Scandinavia)
Virgin Islands

Outline

I. Government
- A. National government
- B. Courts
- C. Local government
- D. Politics
- E. Armed forces

II. People
- A. Ancestry
- B. Language

III. Way of life
- A. City life
- B. Rural life
- C. Food and drink
- D. Religion
- E. Education
- F. Libraries and museums
- G. Arts
- H. Recreation
- I. Social welfare

IV. The land
- A. Land regions
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V. Climate

VI. Economy
- A. Service industries
- B. Manufacturing
- C. Agriculture
- D. Fishing
- E. Transportation
- F. Communication

VII. History

Questions

What do Denmark's folk high schools offer students?
What is Denmark's official church?
What is the major farm activity in Denmark?
Which area has about a fourth of Denmark's total population and almost half the country's manufacturing industries?
What does the *ombudsman* do?
How did Denmark, Norway, and Sweden become united during the late 1300's?
Why can Denmark's rivers not be used to generate hydroelectric power?
How is the Danish broadcasting system supported?
Who united Denmark? When?
Who is known as the father of modern Danish literature?

Additional resources

Denmark. Fodor's Travel, 1998.
Hintz, Martin. *Denmark.* Children's Pr., 1994. Younger readers.
Lauring, Palle. *A History of Denmark.* 1960. Reprint. Dorset Pr., 1991.
Thomas, Alastair H., and Oakley, S. P. *Historical Dictionary of Denmark.* Scarecrow, 1998.

Denominate number, *dih NAHM uh niht,* tells the amount of a quantity by giving the number of units and the kind of units that make up the quantity. A denominate number includes a number, which may be written as a numeral or as a word, and the name or symbol of a unit of measurement. *Six meters, 90 pounds, $500 million, 18½ miles, 23° C,* and *four days* are all denominate numbers.

See also **Unit.** Karen Connors Fuson

Density is the *mass*—that is, the amount of matter—in a unit volume of any substance. Earth scientists use density measurements to identify minerals and other solids. Chemists measure the density of a solution to determine the concentration of a substance in that solution. They also calculate the molecular weight of a gas from its density (see **Molecule** [Individual molecules]).

The density of a substance equals its mass divided by its volume. Density is commonly expressed in grams per milliliter or pounds per cubic foot.

To determine the density of a regularly shaped solid, first measure the object's mass—that is, weigh the object. Next, measure one or more of the object's dimensions and calculate its volume from a mathematical formula for objects of that shape. Then divide the mass by the volume.

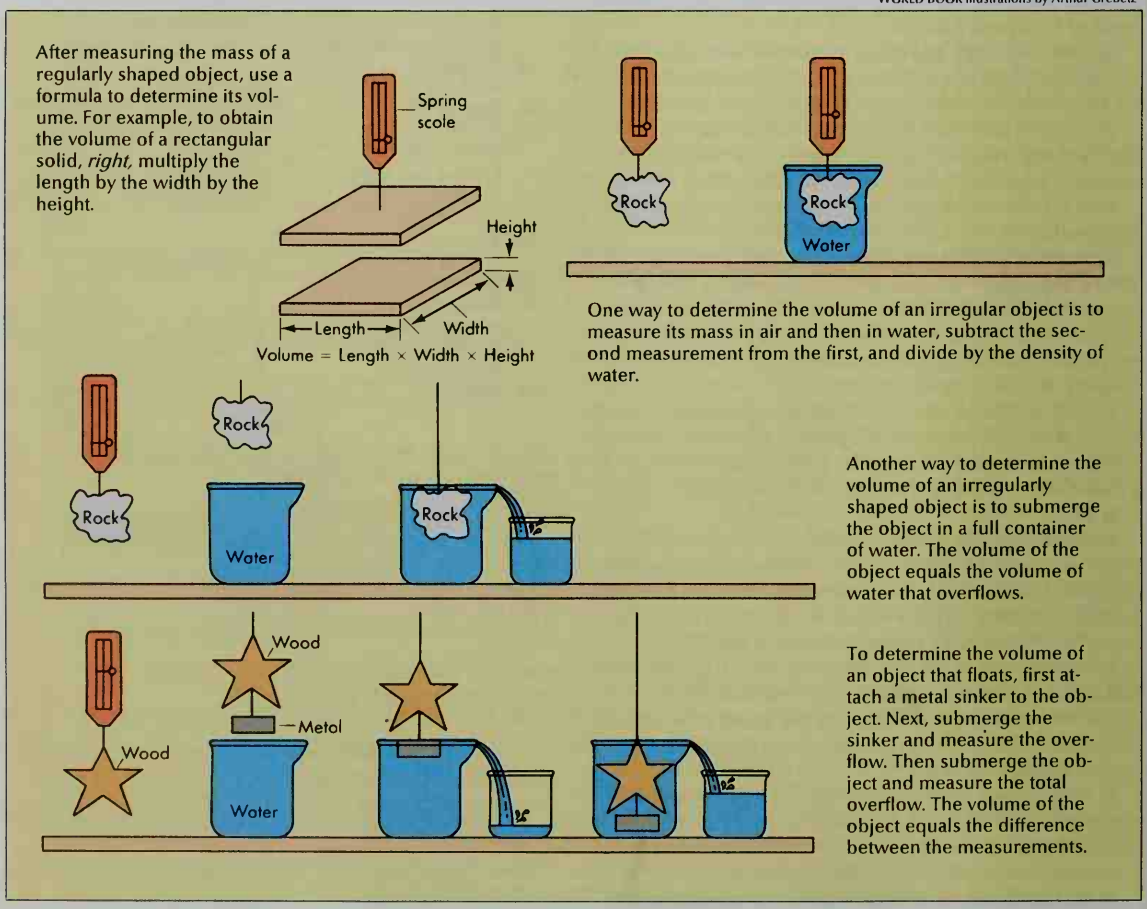
It is more difficult to find the density of an irregularly shaped solid because the volume is harder to determine. Two ways to determine the volume of such an object call for submerging the object in water. To use the first method, submerge the object, then measure the volume of the water displaced. This volume equals the volume of the object. To use the second method, weigh the object in air, then suspend it in water and weigh it again. The volume equals the apparent decrease in mass divided by the density of water.

The density of a gas is difficult to measure because gases have low densities and the density of gases changes greatly with variations in temperature and pressure. To determine the mass of a gas, first weigh an empty container. Next, fill the container with the gas and weigh it again. Then subtract the first measurement from the second. To determine the volume of the con-

How to find the density of a solid object

To find the density of a solid object, measure its mass and determine its volume, then divide the mass by the volume. A mathematical formula can be used to calculate the volume of a regularly shaped object. If the object is irregularly shaped, its volume can be determined by measuring the volume of water it displaces when submerged.

WORLD BOOK illustrations by Arthur Grebetz



tainer, measure the amount of water that the container holds.

The *specific gravity* of a substance is related to its density. Specific gravity equals the mass of a given volume of the substance divided by the mass of an equal volume of water. To determine the specific gravity of a substance, divide the density of the substance by the density of water at either 4 °C (39 °F) or 20 °C (68 °F).

Peter A. Rock

For the densities of the elements, see **Element, Chemical** (table).

Density of population. See **Population** (World population); **World** (People of the world).

Dent, John Charles (1841-1888), was a Canadian journalist and historian. He is best known for *The Last Forty Years,* a history of Canada from 1841 to 1881. He also wrote *The Canadian Portrait Gallery* and *The Story of the Upper Canadian Rebellion.*

Dent was born at Kendal, England, but came to Canada as an infant with his parents. He became a lawyer, but practiced for only a short time. He returned to England and served as a journalist with the *London Daily Telegraph.* He became editor of the *Evening Telegram* in 1876, and later joined the editorial staff of the *Globe* of Toronto. David Jay Bercuson

Dental Association, American, is a national organization of dentists. Its purpose is to promote oral health care and the art and science of dentistry. The association has more than 500 local dental societies in the United States and its possessions. It has more than 148,000 members. The American Dental Association was founded in 1859. Headquarters are at 211 E. Chicago Avenue, Chicago, IL 60611.

Critically reviewed by the American Dental Association

Dental hygiene is the science and practice of preventing diseases of the teeth, gums, and other parts of the mouth. A dental hygienist is a licensed professional who provides services to help children and adults maintain good oral health.

What dental hygienists do. The dental hygienist cleans and polishes the teeth to help prevent gum disease and tooth decay. The hygienist also examines the mouth for signs of disease. The examination may include X rays of the teeth and jaws to locate dental decay or bone abnormalities. The hygienist may apply fluorides and plastic *sealants* to the teeth to help prevent cavities. The hygienist also may provide instruction to individuals and groups about the proper care of the mouth.

Education. Accredited schools of dental hygiene require that applicants have at least a high school education. People who enter schools of dental hygiene may choose either of two kinds of programs. They may take a two-year course—which leads to a certificate, a diploma, or an associate degree—or a four-year course to earn a bachelor's degree. Subjects studied include anatomy, chemistry, and microbiology. They also include such special subjects as dental anatomy, dental health education, and the clinical practice of dental hygiene skills.

All states require dental hygienists to have a license to practice. In every state except Alabama, applicants must pass both national board examinations and state or regional board examinations to get the license. Alabama allows *preceptor training* of dental hygienists, an apprenticeship program under the supervision of a dentist. People who complete a preceptorship are still required to complete a dental hygiene program at an accredited school if they wish to apply for a license in another state.

Career. Most dental hygienists work with dentists in private dental offices. Others work in industrial and hospital clinics, do public health work in government and private health agencies, or teach in schools of dental hygiene. For information about a career in dental hygiene, write to the American Dental Hygienists' Association, 444 N. Michigan Avenue, Chicago, IL 60611.

Critically reviewed by the American Dental Hygienists' Association

See also **Teeth** (Care of the teeth and gums).

Dentistry is the art and science of diagnosing, treating, and preventing diseases of the teeth, jaws, and surrounding soft tissues of the mouth. Dentists care for their patients in many ways, but mainly through their skill at recognizing, correcting, and preventing problems of the teeth and the tissues that support them.

Dental treatment includes a wide range of dental services. Some of these services focus on correcting problems of the teeth caused chiefly by dental decay. Such treatment, called *restoration,* often involves the use of some kind of dental filling. Other dental services deal with the prevention and treatment of diseases of the teeth and their supporting tissues and nerves. Still others concentrate on the position of the teeth in relation to each other and to the jawbones. Sometimes teeth require removal. This process, usually performed using an *anesthetic* (painkilling drug), is called *extraction.* Dentists may also treat injuries, infections, tumors, and various other conditions of the teeth, jawbones, and related tissues.

Dentistry is practiced in dental offices where one or a number of dentists treat patients. Dentistry is also practiced in large clinics, in hospitals, and in dental schools. Dental schools, in addition to training future dentists, also conduct research. This research provides improvements in the diagnosis and the treatment of dental disorders.

Branches of dentistry

A number of branches of dentistry have been established. They include (1) general dentistry, (2) orthodontics, (3) oral surgery, (4) periodontics, (5) prosthodontics, (6) oral pathology, (7) pediatric dentistry, and (8) endodontics.

General dentistry involves all phases of dental practice. Much dental practice is concerned with the prevention of mouth diseases. Dentists teach patients techniques for cleaning teeth correctly at home. They help patients establish nutritious eating habits that help keep teeth and gums healthy. Dentists also may clean the patient's teeth and gums. In many dental offices, specially trained *dental hygienists* help dentists with these activities (see **Dental hygiene**).

General dental treatment includes filling cavities, extracting teeth, and replacing lost teeth with *bridges* or *dentures* (see **Teeth** [Dental decay]). Difficult problems are sometimes cared for by specialists in other branches of dentistry.

Orthodontics specializes in the correction and prevention of irregularities of the position of teeth. These ir-

WORLD BOOK photo by Jim Ziv

Dentistry involves diagnosing, treating, and preventing diseases of the teeth, gums, and jaws. Regular checkups are part of good dental care. In this photo, a dentist examines a patient's teeth during an office visit.

regularities usually happen as the teeth grow during early childhood and may produce *malocclusion* (bad bite). The majority of malocclusions occur because the teeth are too large for the amount of jaw space available. As a result, the teeth become crowded. Orthodontists correct malocclusions with braces or other mechanical devices that move the teeth into a better position. They may also use orthodontic techniques to correct facial profile irregularities. See **Orthodontics**.

Oral surgery is concerned with the surgical correction of oral problems. Many of these problems are associated with the *third molars,* also called *wisdom teeth.* These teeth may be too difficult to remove in a regular dental office if they are *impacted* (heavily wedged) in the jawbone. Oral surgeons remove tumors and cysts from the mouth and treat teeth and jaw fractures caused by injuries. They also correct cosmetic problems of the jaws and face, using methods similar to plastic surgery.

Periodontics deals with diseases of the tooth-supporting tissues—the bones surrounding the teeth, the *ligaments* between bones and teeth, and the gum tissue. Periodontal diseases are responsible for more tooth loss in adults than any other dental problem. They can be prevented by proper home dental care.

WORLD BOOK photo by Jim Ziv

Braces for teeth consist of bands connected by wires and, sometimes, small rubber bands. Orthodontists use braces to correct irregular positioning of the teeth and jaws.

Prosthodontics deals with the replacement of missing or damaged teeth. Replacement often involves the construction of complete or partial dentures, which are removable devices. Sometimes missing teeth are replaced by bridgework cemented to the remaining teeth. Replacements are made of plastic, porcelain, gold or other metals, or combinations of these materials.

Oral pathology deals mainly with the diagnosis of mouth diseases using laboratory procedures. Soft or hard tissues from the patient's mouth may be examined with the aid of a microscope to identify tumors or other disorders. Some oral pathologists also specialize in *forensic dentistry,* which applies oral pathology to legal cases. These specialists are frequently called upon to identify dead people by comparing dental records with the teeth and tissues of the deceased.

Pediatric dentistry specializes in the dental problems of children. Dentists who practice pediatric dentistry are called *pedodontists.* Children sometimes require special attention in treating dental decay and other problems. Pedodontists also care for other special patients, such as adults who have mental or physical disabilities.

Endodontics involves prevention, diagnosis, and treatment of diseased *pulp* and other dental tissues. The pulp is the central portion of the tooth that contains nerves and blood vessels. Severe dental decay and other injuries may cause infection or death of the pulp. This pulp can be removed by a process known as *root canal treatment.* Once removed, the pulp can be replaced with special filling material. Such treatment saves many teeth that would otherwise be extracted.

History

Early dentistry. Human beings have always experienced dental problems. The ancient Greeks, Romans,

and Egyptians used various remedies for toothaches, including tooth extraction. People in early civilizations even developed gold dental bridges. In the Middle Ages, dentistry was practiced by such craftworkers as jewelers and barbers.

In 1728, Pierre Fauchard, a French dental scientist, published *The Surgeon Dentist.* This book detailed complex dental devices, instruments, and methods and is considered a landmark in the history of dentistry. Dentistry emerged as a profession in the mid-1800's. In 1840, the world's first dental school, the Baltimore College of Dental Surgery, was founded in Baltimore by the American dentists Horace Hayden and Chapin Harris.

The teeth of the American colonists of the 1600's and 1700's were considered the worst in the world. Poor diet and inadequate dental cleaning and maintenance caused many colonists to lose at least half of their teeth before the age of 20. The founding of the first dental schools in the United States marked the beginning of the solution of this problem for Americans. The United States then became the world's leading center for dental learning and practice.

Modern dentistry began during the mid-1800's with the introduction of *general anesthetics* to relieve discomfort during dental procedures. General anesthetics make patients unconscious and unable to feel pain throughout the body. Nitrous oxide was first used as a general anesthetic by the American dentist Horace Wells in 1844. Two years later, another American dentist, W. T. G. Morton, gave the first formal demonstration of the use of ether as an anesthetic (see **Morton, William T. G.**).

In 1884, the American physician William Halsted used cocaine to block pain sensations in the lower jaw. Cocaine was the first *local anesthetic*—that is, a drug that blocks pain in only part of the body and does not cause unconsciousness.

By 1900, the use of dental drills had become widespread in the United States. In addition, principles for filling cavities had been established through the work of the American dentist G. V. Black. These important developments, along with the discovery of X rays in 1895 and the use of silver filling materials, helped revolutionize dentistry.

Granger Collection

A traveling tooth-puller, like the one shown here, was one of many untrained people who practiced dentistry in the 1700's. Dentistry became a recognized profession during the 1800's.

Since the 1950's, the addition of *fluorides* to water supplies and toothpastes has greatly reduced tooth decay (see **Fluoridation**). The development of high speed dental drills has lessened the pain involved in dental procedures. In addition, the development of plastic filling materials has enabled dentists to cover up unsightly discolorations, cracks, or gaps in teeth.

Careers

Dentistry in the United States and Canada is a large and well-organized profession. There are about 145,000 dentists in the United States and about 14,000 dentists in Canada. The great majority of these dentists have a private dental practice. Most of the remaining dentists work in the military, in public health, in various government organizations and dental societies, as consultants, or as teachers or researchers in dental schools. People who want to become dentists must first attend a school of dentistry. There are about 60 dental schools in the United States and about 10 in Canada.

Educational requirements. All dental schools require a high level of scholastic achievement before admission. Applicants must have at least two years of college education, but most dental students are college graduates. Prospective dental students must also take a dental aptitude test. This test identifies those students who are most likely to succeed in dental subjects.

The usual course of study in dental school lasts four years. The first two years are devoted to studying basic medical and dental sciences, as well as dental laboratory techniques. Clinical aspects of dentistry are emphasized in the final two years of dental school. During that time, students perform dental procedures on patients. Upon graduation, students receive either a Doctor of Dental Surgery (D.D.S.) degree or a Doctor of Dental Medicine (D.M.D.) degree.

Licensing. All U.S. states and Canadian provinces require that dentists be licensed to practice. To obtain a license, a person must have a D.D.S. or D.M.D. degree from an approved school and must also pass a special examination. State and local dental societies work with state governments in administering licensing examinations.

Organizations. The main professional organization of dentists in the United States is the American Dental Association. Some functions of this organization are to promote dentistry in matters of legislation, to inspect and approve dental schools, and to produce educational material for the public. Its headquarters are in Chicago, Illinois. The Canadian Dental Association serves a similar purpose in Canada. It has headquarters in Ottawa, Ontario. John P. Wortel

See also **Teeth; Dental Association, American; Hypnotism** (Uses of hypnotism); **Prosthetics; Orthodontics.**

Additional resources

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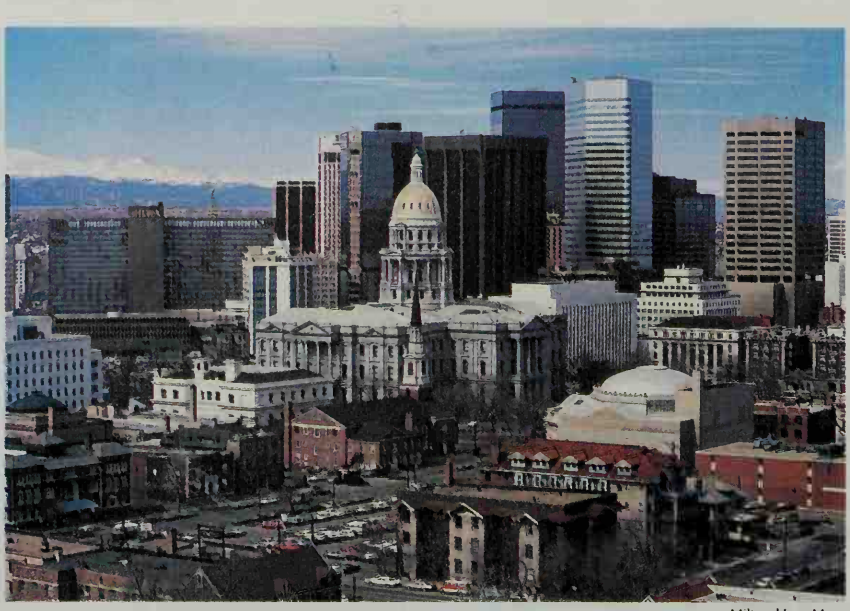
Taintor, Jerry F. and M. J. *The Complete Guide to Better Dental Care.* Facts on File, 1997.

Wynbrandt, James. *The Excruciating History of Dentistry.* St. Martin's, 1998.



Milt and Joan Mann

Downtown Denver is the commercial center of the Rocky Mountain region of the United States. The domed Colorado Capitol, *center,* stands near the business district.

Denver is the capital and largest city of Colorado. It is the distribution, manufacturing, and transportation center for the Rocky Mountain region of the United States. The city is also a central point for snow sports and serves as a gateway to nearby mountain vacation spots.

Denver lies in the north-central part of Colorado on the South Platte River, 10 miles (16 kilometers) east of the Rocky Mountains. It is called the *Mile High City* because the Capitol stands on land 1 mile (1.6 kilometers) above sea level.

When gold prospectors founded Denver in 1858, it formed part of the Kansas Territory. The town was named for James W. Denver, governor of the territory. Denver became the capital of the Colorado Territory in 1867 and the capital of Colorado when it became a state in 1876.

From 1860 to 1945, Denver was a mining and agricultural community. The city's population increased greatly before and during World War II (1939-1945). After the war ended, Denver became known for its industries. Between 1945 and 1980, Denver's continued expansion in industry and population made it one of the nation's fastest-growing cities. Denver's population decreased during the 1980's, however, but began growing again during the 1990's.

Facts in brief

Population: 554,636. *Metropolitan area population*—2,109,282. *Consolidated metropolitan area*—2,581,506.
Area: *City*—114 mi² (295 km²). *Metropolitan area*—3,778 mi² (9,785 km²). *Consolidated metropolitan area*—4,528 mi² (11,727 km²).
Altitude: 5,280 ft (1,609 m) above sea level.
Climate: *Average temperature*—January, 30 °F (-1 °C); July, 73 °F (23 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—15 in (38 cm). For the monthly weather in Denver, see Colorado (Climate).
Government: Mayor-council. *Terms*—4 years for the mayor and the 13 council members.
Founded: 1858. Incorporated as a city in 1861.
City flag: The blue, red, white, and yellow design symbolizes the sky, soil, mountains, and sun.
City seal: The black and gold circular seal has an eagle, a shield with a key, a smokestack, the state Capitol, a setting sun, and the words *City and County of Denver Seal.*

The city covers 114 square miles (295 square kilometers) and has the same boundaries as Denver County. Denver, its suburbs, and nearby Boulder form part of a consolidated metropolitan area that covers 4,528 square miles (11,727 square kilometers).

Broadway, Colfax Avenue, and Larimer Street form a triangle around Denver's downtown business district. Cherry Creek joins the South Platte River northwest of the triangle. Skyscrapers with banks and investment firms make 17th Street the "Wall Street of the West."

The 16th Street Mall, a 14-block-long pedestrian mall, is located in downtown Denver. During the day, downtown office workers and shoppers mingle among the mall's colorful pushcarts, street musicians, and old-fashioned horse-drawn carriages. Many apartment buildings have been constructed near the west end of the mall.

Southeast of the city's main business district, the Civic Center includes the City and County Building, the Colorado State Capitol, the Denver Art Museum, and the Denver Public Library. West of the business district stand the city's sports complex, an amusement park, the City Auditorium and Theater, and the Colorado Convention Center.

The people. About 22 percent of Denver's people are of Mexican ancestry. African Americans form about 12 percent of the population. Denver also has a small number of American Indians and people of Asian descent.

Economy. The federal government and the state government are among Denver's major employers. The city serves as the national or regional headquarters of more federal agencies than any other city in the United States except Washington, D.C. The Denver mint, which is near the Capitol, makes millions of United States coins every year.

The Denver area has a number of telecommunications and high technology companies as well as manufacturing plants. Food processing ranks among the top manufacturing activities. Other manufactured products include beverages, computer and electronic components, fabricated metal products, and transportation equipment.

A large number of warehouses help make Denver the distribution center of the Rocky Mountain region. The city also serves as the region's transportation center. Airlines use Denver International Airport. Railroad passenger trains, freight lines, and several highways also serve the city.

Denver has two daily newspapers. They are *The Denver Post* and the *Denver Rocky Mountain News.*

Education. Denver's public school system has about 80 elementary schools, 20 middle schools, and 10 high schools. The city also has almost 60 church-supported schools.

A seven-member board of education runs the public schools. Board members are elected to six-year terms.

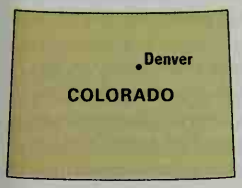
Denver is the home of several colleges and universities. The schools include the University of Colorado Medical School, Baptist Seminary, the University of Denver, Iliff School of Theology, Metropolitan State College of Denver, the National Theatre Conservatory, and Regis University.

Cultural life and recreation. The Denver Art Museum owns one of the world's finest collections of Western Indian art. The Colorado History Museum, which is located in Denver, has a fine exhibit on early cliff dwellers of the area. The Denver Public Library is the largest in the Rocky Mountain region.

The Colorado Symphony Orchestra performs in the Denver Performing Arts Center. The Elitch Summer Theater is the oldest theater in the United States with a permanent group of performers. The theater was established in Denver in 1891.

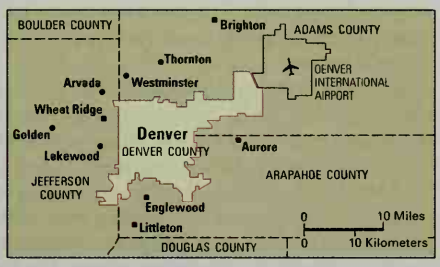
Denver maintains about 100 parks in the city and about 32 square miles (83 square kilometers) of parkland

Denver

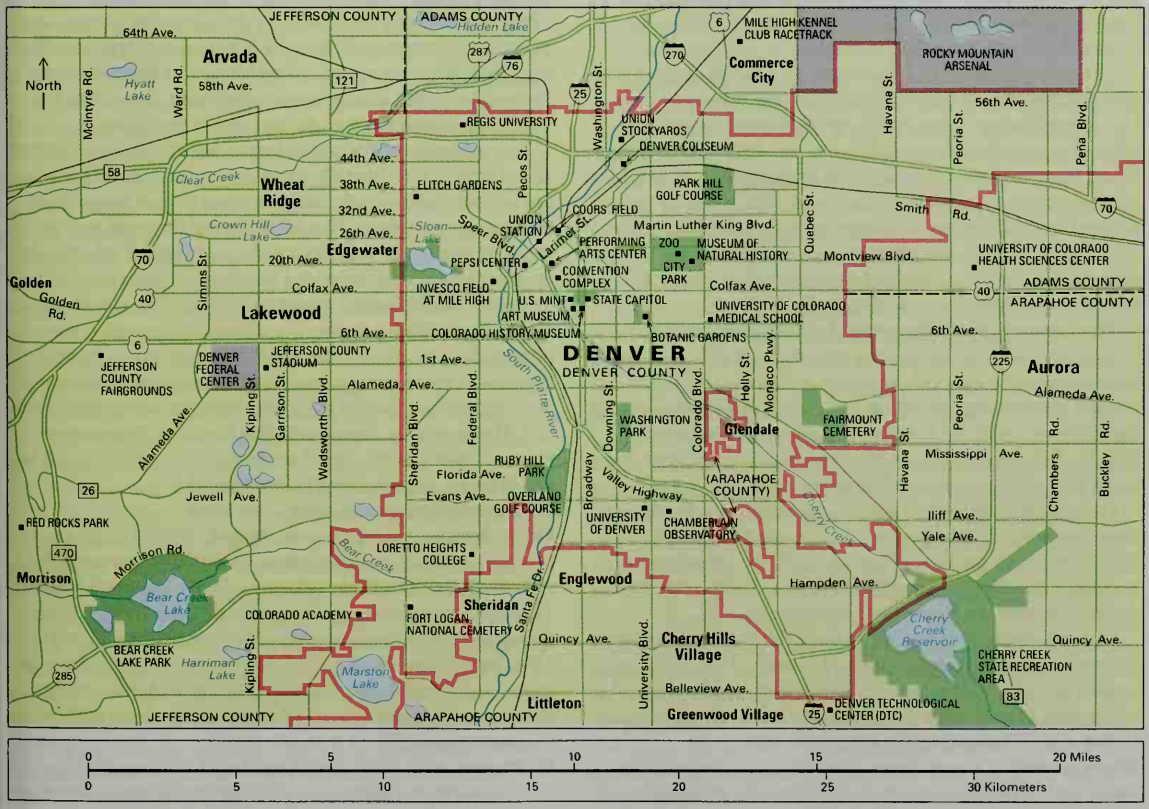


Denver lies in north-central Colorado. The map at the right shows the surrounding area. The map below shows the city and its main points of interest.

City boundary
County boundary
Expressway
Other road
Railroad
Point of interest
Federal area
Park or cemetery



WORLD BOOK maps



in the Rocky Mountains. Winter Park, a city-owned ski resort, lies in the mountains.

Denver has several professional sports teams. The city's teams include the Colorado Rockies baseball team of the National League, the Denver Nuggets of the National Basketball Association, the Denver Broncos of the National Football League, and the Colorado Avalanche of the National Hockey League.

Government. Denver has a mayor-council form of government. The people elect a mayor and 13 city council members—all to four-year terms.

In 1902, Denver led a home-rule movement among the cities of Colorado. As a result of this home-rule movement, an amendment to the state Constitution made Denver both a city and a county. Denver gets most of its income from taxes on personal property, real estate, and general sales.

History. Denver was founded in 1858, after prospectors found gold in the area. The community became a supply point for mining settlements during the "Pikes Peak or Bust" gold rush of 1859. Denver and nearby Auraria merged in April 1860. The next year, Denver was incorporated as a city. The city became capital of the Colorado Territory in 1867 and the capital of Colorado when it became a state in 1876.

Denver expanded with completion of the Denver Pacific Railroad in 1870. A silver-mining boom gave the city additional wealth during the 1880's and 1890's.

During the early 1900's, Denver changed from a prairie town to a beautiful city. The city's government established many parkways and planted trees throughout Denver. By 1910, the city had become the commercial center of the Rocky Mountain region. The Moffat Tunnel, a mountain railway route from Denver through James Peak, was completed in 1927.

The population of the Denver area soared during and after World War II (1939-1945). Many members of the U.S. armed forces who had been stationed in the area moved there after the war. During the 1970's, Denver faced the problem of preserving its natural beauty while continuing to expand its industry. In 1968, Denver prohibited open burning of wastes by city agencies to lessen air pollution. Since 1968, the South Platte Area Development Council has worked with the city to reduce industrial pollution on the South Platte River.

The Denver Urban Renewal Authority began the Skyline Project in 1968 to replace and restore old, run-down buildings in the city's downtown area. This project includes apartment and office buildings, the Japanese Cultural Center, and the Denver Performing Arts Center. The Skyline Project was completed in 1985. In 1990, the huge Denver Convention Complex opened.

One of Denver's most successful suburban business developments is the Denver Technological Center (DTC), an office park southeast of the city. Development began in the 1960's and still continues. Today, the DTC is the home of more than 1,000 companies.

In April 1999, tragic news came from Columbine High School in the Denver suburb of Littleton. Two students armed with guns and bombs had killed 13 people and wounded 23 and then killed themselves. Janet Day

See also **Colorado** (pictures).

Deodorant is a consumer product or an ingredient designed to reduce, prevent, or cover up unpleasant body odors. Most external body odor occurs when bacteria react with perspiration and secretions on the skin. Perspiration itself has no odor. Deodorants generally contain chemicals that stop bacteria growth. Many contain a fragrance that masks odor. Deodorants called *antiperspirants* also reduce the amount of perspiration.

The word *deodorant* is most frequently associated with personal products that act against underarm odor. But deodorants are also made for the feet and genital area, and to reduce odors from surgical openings and those caused by various disorders. Deodorants are manufactured in the form of creams, roll-on liquids or lotions, sticks, and sprays. Common antibacterial ingredients in deodorants include zinc or magnesium salts, benzethonium chloride, and triclosan. Aluminum, zirconium, or aluminum-zirconium compounds in most antiperspirants act to reduce perspiration.

Antiperspirants alter a body function and so are classified as drugs by the United States Food and Drug Administration (FDA). They must meet FDA regulations for safety and effectiveness. Underarm deodorants that do not contain an antiperspirant ingredient are not subject to these regulations. Clarence R. Robbins

Deodorizer is a substance or device that eliminates or reduces disagreeable odors. Such odors are sometimes called *malodors*.

Most deodorizers are *masking deodorizers,* which emit fragrances to cover malodors. Masking deodorizers include incense, scented candles, fragrant sprays, and fragrant gels. Deodorizers called *disinfectants* are applied to surfaces on which bacteria that cause malodors live. The disinfectants eliminate odor by killing the bacteria. Many disinfectants also contain a fragrance. *Chemical deodorizers,* such as the chemical compounds *potassium permanganate* and *hydrogen peroxide,* eliminate malodors by means of *oxidation.* In this process, oxygen from the compounds eliminates the odors by combining with chemicals that cause the odors.

To eliminate malodors in large buildings, *mechanical deodorizers* are typically used. Most such deodorizers are *air cleaners,* which remove from the air impurities that cause malodors. The air is drawn through the devices by means of fans. In air cleaners called *electrostatic precipitators,* wires give a positive electric charge to airborne particles that cause malodors. The positively charged particles are then captured on negatively charged metal plates. Other air cleaners use a *scrubbing* process. In one such process, air that contains malodorous particles is forced through water or some other liquid. The particles dissolve in the liquid and so are removed from the air. See **Air cleaner.** Patricia Ann Mullen

De Oñate, Juan. See Oñate, Juan de.

Deoxyribonucleic acid. See DNA.

De Palma, *duh PAHL muh,* **Ralph** (1883-1956), was a pioneer American automobile race driver. He won the Indianapolis Speedway 500-mile (805-kilometer) race in 1915 and the national driving title in 1912 and 1914. De Palma set a world record of 149.875 mph (241.2 kph) in 1919. He claimed 2,557 victories in 2,889 races. Many of these were match races against another driver, rather than open competition. De Palma was born in Italy. Sylvia Wilkinson

DePaola, *duh POW luh,* **Tomie,** *TAHM ee* (1934-), is an American children's book illustrator and author. In

some books, his name is written de Paola. DePaola gained recognition for his imaginative and colorful illustrations for children's books, especially nursery rhymes and folk tales. He received the 1983 Regina Medal from the Catholic Library Association for his "continued distinguished contribution to children's literature."

Thomas Anthony dePaola was born in Meriden, Connecticut. DePaola has illustrated dozens of children's books, notably *Charlie Needs a Cloak* (1973), *Tomie dePaola's Mother Goose* (1985), and several stories about a character from Italian folklore named Strega Nona. The Strega Nona books include *Strega Nona: An Old Tale* (1975) and *Strega Nona Meets Her Match* (1993). He also wrote the autobiographical *26 Fairmont Avenue* (1999).

DePaola has also painted murals and other works for churches. He has designed greeting cards, posters, magazine and catalog covers, record album covers, and theater sets. He has also exhibited his paintings in one-man shows and group shows. Ann D. Carlson

Department of ... See the articles on the executive departments of the United States government listed under their key word, as in **Labor, Department of.**

Department store is a large store that sells many kinds of goods in separate departments under one management. It also provides a variety of services. In a typical department store, perfumes, jewelry, and similar articles are on the first floor, and clothing, furniture and appliances are on the upper floors. Some department stores also sell bargain merchandise in the basement.

Many historians believe that Aristide Boucicaut, a French merchant, established the first department store. Boucicaut managed a store in Paris called *Bon Marché* (French for *good bargain*). Bon Marché originally sold only fabrics, but in the 1850's, it began to sell a large variety of goods, arranged by department. Boucicaut's retailing practices were quickly copied by such American businessmen as Marshall Field, Eben Jordan, Rowland H. Macy, Benjamin L. Marsh, Alexander T. Stewart, and John Wanamaker. By the early 1900's, department stores had spread throughout the United States.

Early department stores differed from those of today in a number of ways. For example, the first department stores were established in downtown areas, but many are now located in suburbs. The early department stores were one-store operations. Today, the majority of department store organizations have several stores within a metropolitan area—or even in different cities. Originally, department stores provided a high level of personal service to their customers in all departments. Many modern stores, however, have some departments that are largely self-service. The first department stores occupied several stories and offered a great variety of merchandise. Today's newer department stores occupy only a few floors and sell a smaller variety of goods. In addition, many department stores now sell merchandise through direct-mail activities and other methods.

Some of the better-known U.S. department stores include Bloomingdale's and Macy's, owned by Federated Department Stores of Cincinnati, Ohio; Marshall Field's, owned by Target Corporation of St. Paul, Minnesota; Dillard Department Stores of Little Rock, Arkansas; May, Lord & Taylor, and Filene's, owned by May Department Stores Company of St. Louis, Missouri; and Neiman-Marcus of Dallas. The leading Canadian department stores are Sears Canada and the Bay, owned by the Hudson's Bay Company. Both companies have their headquarters in Toronto, Ontario. William H. Bolen

Related articles in *World Book* include:

Chain store
Discount store
England (picture; Harrods)
Mail-order business
Retailing
Sears, Roebuck & Co.

De Paul, Saint Vincent. See Vincent de Paul, Saint.

Depilatory, *dih PIHL uh TAWR ee,* is a chemical cream or lotion that removes hair. Depilatories are applied directly to the hair and skin. They contain alkaline agents that break down the structure of hair. Depilatories do not affect the hair root, so the hair will grow back. Depilatories can irritate skin. Hair can be permanently removed through *electrolysis.* In electrolysis, an electric current is passed through each hair root. Several treatments may be needed before the hair root dies. Electrolysis can cause inflammation and pain and should only be performed by a trained operator.

Deportation is the action a government takes when it forces an alien to leave the country and return to the place where the alien was born or had lived. A government may deport an alien because the person entered the country illegally, or because it is believed he or she may harm the nation's interests in some way.

In the United States, the attorney general has the power to deport aliens as part of his or her responsibility to enforce immigration laws. Aliens may be deported if they become public charges, stay longer than their visas permit, or engage in subversive or criminal activities. Naturalized citizens who lose their citizenship may be deported by the Department of Justice.

Deportation also means banishing, or sending a convict to a penal settlement outside the country as punishment for a crime. Robert J. Pranger

Deposition, *DEPH uh ZIHSH uhn,* in law, is a witness's testimony that is taken outside of court. Lawyers usually obtain depositions from a person who is unable to appear in court. Lawyers may also take a deposition before a trial to discover existing evidence or leads to new evidence. In a deposition, the witness testifies under oath before a notary public or other judicial officer. The testimony in a deposition consists of a statement in answer to questions, either oral or written, asked by the officer.

When one party in a lawsuit arranges for a deposition, all other involved parties must be notified. They must have the opportunity to be present at the deposition and to question the witness. Sherman L. Cohn

Depreciation, *dih PREE shee AY shuhn,* is the loss of value. Buildings, machines, vehicles, and other property *depreciate* (lose value) through use or accident, because they grow older, or because a new, better product replaces them. In accounting, depreciation is figured as a normal cost of doing business. In addition, the term *depreciation* is used to mean the loss of value or of purchasing power resulting from an increase in the level of domestic prices. In this sense, the term refers to the currency of a country declining in value relative to currencies of other countries. See also National income (Determining national income). Irving Morrissett

Depressant is the former name for a group of drugs that slow the activity of the nervous system. Today, physicians call these drugs *antianxiety and hypnotic drugs.* They are used to ease pain, cause sleep, or reduce ten-

sion. Many are either habit-forming or addictive. If a person takes such a drug daily for several weeks, a physical or psychological dependence on it may develop. An overdose can be fatal.

Antianxiety and hypnotic drugs include alcohol, sedatives, tranquilizers, and benzodiazepines. Alcohol decreases most functions of the brain. Sedatives calm a patient or bring on sleep. Tranquilizers lessen tension without decreasing physical activity. Benzodiazepines are a class of depressants frequently described as both sedatives and tranquilizers. Christopher A. Rodowskas, Jr.

See also **Drug** (Antianxiety and hypnotic drugs); **Alcoholism** (Effects); **Sedative; Tranquilizer**.

Depression is a deep, extended slump in total business activity. Buying and selling drop during a depression, causing a decline in production, prices, income, and employment. Money becomes scarce. Many businesses fail, and many workers lose their jobs. A depression can hit an industry, a region, a nation, or the world.

A depression might develop if sales drop in a number of stores. Because of the fall in sales, the stores order less merchandise from manufacturers. The manufacturers, in turn, lower production, cut orders from suppliers, and invest less money in new equipment and factories. As sales drop, prices tend to fall, further reducing business income. Employers lay off workers as business income falls. Bankruptcies may follow.

The depression cycle occurs again and again as unemployment rises. Unemployed workers have less money to spend, leading to further drops in sales, production, income, and employment. The slump feeds on itself, becoming progressively worse until business activity picks up.

Not all business slumps grow into depressions. A milder slowdown in business activity is called a *recession*. Some depressions last several years, but most recessions last only a year or less. In the United States and other industrial nations, depressions and recessions alternate with business expansions. This alternation is called the *business cycle*.

Severe depressions occurred in the United States in 1837, 1873, 1893, 1907, and 1929. Financial panics at the start of these depressions sharply reduced the amount of money available for spending. Depressions have also occurred after wars, when wartime spending suddenly stops. The worst depression in history was the Great Depression, which struck the world in 1929 and continued through the 1930's.

Effects

Effects on individuals. Depressions hurt great numbers of people, especially workers who lose their jobs. Bank failures wipe out the savings of depositors if such funds are not insured. Many people cannot meet rent or mortgage payments and lose their homes.

During a depression, some people must live on charity to survive. They may feel angry and humiliated because they cannot support themselves.

Depressions cause marriage and birth rates to decline. Young people who cannot find jobs delay marriage. Couples uncertain about the future may have fewer children than they would like.

Long periods of unemployment cause people to lose faith in themselves and in the future. After a depression, many people value security above all else.

Culver

Lines of jobless Americans were a common sight in many large cities during the Great Depression of the 1930's. Men in this bread line in Brooklyn were waiting for free food.

Some people profit from a depression. For example, people who have enough money can buy businesses, stocks, and other property at low prices. Salaried workers may live better as prices drop and their income buys more.

Effects on society. Society suffers as a depression spreads mass unemployment, poverty, and despair. Depressions also change certain beliefs. These changes can affect society. The Great Depression caused many people to distrust business and led the government to regulate business and economic affairs. This increased regulation led to the widespread belief that the government should maintain high employment and guarantee citizens a good life. After the Great Depression, many people no longer trusted employers to protect workers. As a result, labor unions gained more members and greater public acceptance than ever before.

A depression makes some people lose faith in their system of government. They may come to believe any leader who promises a change. Leaders who took power during a depression include Adolf Hitler, who ruled Germany as dictator from 1933 to 1945, and Benito Mussolini, dictator of Italy from 1922 to 1943.

Relations between nations suffer during a depression. Each country tries to protect its own interests without concern for other nations.

Causes and prevention

Economists disagree on what causes depressions and how depressions can be prevented. Some believe that psychological factors, such as people's optimism or pessimism, determine decisions to save or to spend.

Several theories maintain that population changes or inventions cause periods of expansion and *contraction* (depression or recession). When immigration or higher birth rates cause a population to grow, demand tends to

increase. When population growth slows down, demand drops. Such inventions as the automobile and color television spur business investment and consumer spending, causing expansion. After demand for these products has been satisfied, spending drops off, resulting in contraction.

Still other theories suggest that during an expansion, businesses invest too heavily in buying equipment and building plants and offices. Then, for some time, they have no need to buy or build, and a contraction results.

Most experts believe that another severe depression can be prevented in various ways. For example, insurance provided by the U.S. government guarantees that bank depositors will not lose their savings. Social Security and unemployment insurance guarantee that people will have some money to spend. In addition, economists can predict swings in the economy. These predictions enable the government to take preventive action.

A government's chief methods of preventing a depression are by its *fiscal policy* and its *monetary policy*. Fiscal policy refers to a government's taxing and spending programs. Monetary policy refers to how a government manages such economic factors as interest rates and the availability of money and loans.

Fiscal policy. John Maynard Keynes, a British economist who published his theories during the 1930's, explained a depression as the result of a drop in *effective demand*—that is, total spending by consumers, business, and government. He believed that increased savings slow the rate of economic growth. According to Keynes, people's decisions to save or spend depend on what they expect the economy to do. If they expect bad times ahead, they may decide to save their money. Similarly, if businesses do not foresee future sales, they will not invest money in new products or equipment.

According to Keynes, a government can prevent depressions by encouraging spending. Tax cuts, for example, give people more money to spend. A government can increase its own spending in such activities as public works and aid to the poor.

Monetary policy is directed by a nation's central bank. The Federal Reserve System, often called the Fed, serves as the central bank of the United States. The Fed works to prevent depressions by influencing interest rates and the availability of money and loans. During an economic slump, the Fed reduces interest rates to make loans less expensive and easier to obtain. These actions give people more money to spend, increasing the demand for goods and services and creating more jobs.

Economists called *monetarists* believe that severe swings in the nation's economy could be prevented if the Fed increased the *money supply* at a steady rate. The money supply is the total amount of money in the country, including cash and bank deposits. Monetarists recommend an annual rate increase of 3 to 5 percent, the approximate rate at which production increases. They point out that the Fed deepened the Great Depression by allowing the money supply to shrink in the 1930's.

In 1979, the Fed began to focus on controlling the money supply as a way of promoting economic stability. But by 1993, it shifted its focus to interest rates. The Fed did so because it felt changes in investment patterns had weakened the relationship between the money supply and the growth rate of the economy. Clair E. Morris

Related articles in *World Book* include:
Business cycle
Grant, Ulysses S. (The Panic of 1873)
Great Depression
Hoover, Herbert C. (The Great Depression)
Keynes, John Maynard
Recession
Roosevelt, Franklin D. (Roosevelt's first Administration [1933-1937])
Unemployment
United States, History of the (The Great Depression)
Van Buren, Martin (The Panic of 1837)

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Depression is a serious mental disorder in which a person suffers long periods of sadness and other unpleasant feelings. The term *depression* also describes a normal mood involving the sadness, grief, disappointment, or loneliness that everyone experiences at times. This article discusses depression as a mental disorder.

Depressed people may feel fearful, guilty, or helpless. They often cry, and many lose interest in work and social life. Many cases of depression also involve aches, fatigue, loss of appetite, or other physical symptoms. Some depressed patients try to harm or kill themselves. Periods of depression may occur alone, or they may alternate with periods of *mania* (extreme joy and overactivity) in a disorder called *bipolar disorder*. This condition is also known as *manic-depressive disorder*.

Psychiatrists do not fully understand the causes of depression, but they have several theories. Some psychiatrists believe that it follows the loss of a relative, a friend, a job, or a valued goal. Many psychiatrists believe that experiences during early childhood may make some people especially subject to depression later in life.

According to another theory, disturbances in the chemistry of the brain occur during depression. Brain cells communicate with one another by releasing chemicals called *neurotransmitters*. Some experts think that certain neurotransmitters become underactive during depression and overactive during mania.

Some women experience temporary depression in the weeks following childbirth. Experts believe that this condition, called *postpartum depression,* is caused by fluctuating levels of hormones following childbirth and difficulty adjusting to the pressures of parenthood. In a few cases, postpartum depression can be severe and require hospitalization.

Treatments for depression include hospitalization, psychotherapy, drugs, and *electroconvulsive* (electroshock) therapy. Hospitalization is an essential treatment for depressed patients who are suicidal. In psychotherapy, the psychiatrist tries to understand (1) the childhood events that make a person subject to depression and (2) the events that preceded the patient's current depression. The most prescribed antidepressant in the United States is a drug called *fluoxetine*. Fluoxetine is marketed under the name *Prozac*. *Lithium carbonate* is a drug used in treating bipolar disorder. Electroconvulsive therapy is generally used as a treatment only for patients who fail to respond to other treatment. Philip A. Berger

See also Antidepressant; Bipolar disorder; Mental illness (Mood disorders); Seasonal affective disorder.

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Depth charge is an underwater bomb designed to disable or destroy submarines when they are underwater. A device called a *fuse* triggers the explosion. It senses water pressure around the weapon and explodes at a preset depth. The explosion creates pressure waves. Depending on how close a submarine is to the explosion, these waves can destroy the vessel or damage important equipment inside it.

The United Kingdom's Royal Navy developed and first used depth charges during World War I (1914-1918). These early charges consisted of metal drums filled with the explosive TNT that were rolled off the *stern* (rear) of a ship. Near the war's end, devices called *K-guns* and *Y-guns* launched depth charges off the sides of ships. Ships dropped patterns of charges around submarines. Aircraft were later used to drop charges. The *nuclear depth bomb,* which produces a wider destructive radius than a traditional depth charge, was introduced in 1964.

Depth charges have since become less important in submarine warfare. Today, such warfare depends much more on precise tracking methods and advanced self-guiding torpedoes. Craig M. Payne

De Quincey, *dih KWIHN see,* **Thomas** (1785-1859), was an English essayist. He wrote a rare kind of imaginative prose that was highly ornate, full of subtle rhythms, and sensitive to the sound and arrangement of words. His prose was as much musical as literary in its style and structure and anticipated such modern narrative techniques as stream-of-consciousness.

De Quincey was born on Aug. 15, 1785, in Manchester. At the age of 19, he began taking opium to ease the pain of severe neuralgic headaches. He was addicted to the drug until he died. He described his addiction in his most famous work, *Confessions of an English Opium Eater* (1821). The work's biographical parts are important as background for dreams De Quincey describes later. In these dreams he examined, with the help of opium, the intimate workings of the memory and subconscious.

De Quincey wrote other imaginative essays describing his visions under the influence of opium. They have a sense of fearful reality, as in "The Vision of Sudden Death" (part of the essay "The English Mail-Coach," 1849). His critical essays include "On the Knocking at the Gate in *Macbeth*" (1823), "On Murder Considered as One of the Fine Arts" (1827), and "The Literature of Knowledge and the Literature of Power" (1848). His autobiographical works include essays on writers of his time, such as William Wordsworth, Samuel Taylor Coleridge, and Charles Lamb. Frederick W. Shilstone

Derain, *duh RAN,* **André,** *ahn DRAY* (1880-1954), was a French artist. He and his friends Henri Matisse and Maurice de Vlaminck were leaders of the Fauves, a group of painters active in Paris in the early 1900's.

Derain's Fauve paintings, his most significant works, feature vivid colors. He often painted with short, broken brushstrokes. Derain's paintings are flat in design, with little use of traditional perspective systems. Many of them show the influence of the artists Paul Cézanne, Paul Gauguin, Claude Monet, and Vincent van Gogh.

Detail from *Barges on the Thames* (1906), an oil painting on canvas; Leeds City Art Galleries

A Derain painting shows the bold brushstrokes and vivid colors typical of the artist's Fauve period of the early 1900's. The painting also reflects Derain's preference for outdoor scenes.

Early in his career, Derain worked in sculpture. He also became noted for his book illustrations and for his costume and set designs for ballets and plays. He was born on June 17, 1880, in Chatou. Nancy J. Troy

See also Fauves (picture).

Derby is the name of several important horse races for 3-year-old thoroughbreds. Horse owners and trainers value victories in important derbies because of the races' rich prize money and tradition.

The world's oldest derby is the Epsom Derby (pronounced *DAHR bee*), which was first held at the Epsom Downs racecourse in Epsom, England, in 1780. The race was founded and named by Edward Stanley, Earl of Derby, a prominent horseman of the day. The most famous and popular thoroughbred race in North America is the Kentucky Derby, modeled after the Epsom Derby. The Kentucky Derby has taken place annually at Churchill Downs in Louisville, Kentucky, since 1875. Other well-known derbies include the Irish Derby, the Santa Anita Derby in California, the Florida Derby, and the Arkansas Derby. William F. Reed

See also Kentucky Derby.

Derleth, August (1909-1971), was an American author and editor known for his stories of fantasy and the supernatural. He also wrote fiction about Wisconsin. In many stories, Derleth wrote of dark forces that involve haunted places and encounters between children and ghosts. In 1939, Derleth and Donald Wandrei founded Arkham House, a publishing firm dedicated to promoting the horror-fantasy stories of Derleth's mentor H. P. Lovecraft. The firm eventually published other American fantasy writers who became well known, such as Ray Bradbury, Robert Bloch, and A. E. van Vogt.

Derleth was also a skilled literary imitator. He created Solar Pons, an imitation of Sherlock Holmes. Derleth also edited more than 40 anthologies of writings by other authors.

August William Derleth was born in Sauk City, Wis.

The region is the setting for his Sac Prairie novels, including *Wind over Wisconsin* (1938) and *Evening in Spring* (1941). William A. Kumbier

Dermatitis, *DUR muh TY tihs,* is an inflammation of the skin that itches or burns. It may show redness, swelling, blisters, oozing, crusting, or scaling. It may be produced by friction, heat, cold, or the sun's rays. But chemical agents most often cause dermatitis. Some substances, such as harsh soap, irritate everyone's skin. Other substances, such as nickel in jewelry, affect only those people who are allergic to them. Plants, dyes, rubber, cosmetics, medications, and industrial chemicals are common causes of dermatitis. See also **Allergy; Eczema.** Yelva Liptzin Lynfield

Dermatology, *DUR muh TAHL uh jee,* is the branch of medicine that deals with the prevention, diagnosis, and treatment of skin diseases. Physicians who specialize in this field are called *dermatologists.*

Skin ailments treated by dermatologists include blisters, burns, infections, inflammations, tumors, and warts. Dermatologists also treat many children and teen-agers who have acne or certain allergies. Dermatologists are trained to recognize changes in the skin that indicate a disease in other parts of the body. For example, a certain type of facial rash may be a symptom of *systemic lupus erythematosus,* a disease that affects many internal organs as well as the skin (see **Lupus**).

Dermatology includes research on the structure and function of skin. Some dermatologists perform surgery to correct certain conditions. David T. Woodley

See also **Skin** and its list of *Related articles.*

Dermis. See **Skin.**

Derrida, *dehr REE duh,* **Jacques** (1930-), a French philosopher, is considered the founder of the *deconstruction* movement. His work has been most influential in literary criticism, but it is becoming increasingly important in the fields of philosophy, law, art, theology, and political science.

Derrida says that, throughout history, philosophers have tried to answer profound questions by setting up precise definitions for terms, constructing solidly logical arguments, and building systems of ideas. They have treated language as a mere tool that communicates ideas without interference or distortion. But Derrida states that in language, especially written language, we mean more and other than we intended to say.

Derrida looks closely at the metaphors, key terms, examples, seemingly incidental remarks, footnotes, and similar features of thinkers' actual language. He traces the implications of these features as they appear in specific texts. Derrida finds that these implications connect into patterns that tangle up or contradict the neat definitions and arguments the philosophers like to think they are making. This process of showing how the actual words of the text tangle and "undo" its intended meaning has come to be called deconstruction.

Derrida's writings take the form of close and often witty and playful readings of texts, usually by philosophers. His most famous book is *Of Grammatology* (1967). He was born in Algiers, Algeria. Donald G. Marshall

Dervish, *DUR vihsh,* is a member of one of the mystical religious orders of the Islamic religion. Most dervishes lead wandering lives of self-denial. They live by begging. The word *dervish* comes from Persian, and means *beggar* or *religious mendicant.* In the A.D. 1000's and 1100's, Muslim mystics organized the first dervish orders. Each order lived in a center resembling a monastery and had its own ritual. One order is known commonly as the *whirling dervishes* because they whirl and dance to the music of a reed pipe as part of their worship. Other orders give special prayers or practice unusual forms of devotion, such as wearing rough clothing, fasting, and keeping vigils. Many Muslims consider dervishes holy, and often think them capable of miracles or predicting the future. Others criticize the dervish orders and practices for introducing changes to fundamental Islam. Dervishes are sometimes called *fakirs.* Richard C. Martin

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Dervishes are members of certain Islamic religious orders. They devote themselves to prayer and other forms of devotion. Members, *above,* dance and whirl as part of their worship.

DES is a synthetic compound that has the properties of natural *estrogens.* Estrogens are hormones that are important in the development and regulation of the female reproductive system. They are produced primarily by the ovaries during a woman's childbearing years. DES is an abbreviation for the compound's chemical name, *diethylstilbestrol.*

Beginning in the 1940's, physicians in the United States prescribed DES to as many as 5 million pregnant women threatened with miscarriages. It was believed that DES helped prevent miscarriages, but later studies failed to support this belief. Furthermore, research revealed that daughters of mothers treated with DES have an increased risk of developing cancer of the *cervix* or *vagina.* The cervix and vagina are parts of the female reproductive system. There is also some evidence that daughters of mothers who used DES may have structural abnormalities of the sex organs, causing fertility and pregnancy problems. Other studies have shown that sons of mothers who used DES may have structural abnormalities of the urinary system and sex organs. In 1971, the United States Food and Drug Administration (FDA) withdrew its approval for the use of DES during pregnancy.

For many years, farmers in the United States used DES to increase the growth and size of cattle and sheep. In 1979, the FDA banned the use of DES in animal feed because some of the compound remained in the meat.

Today, DES is occasionally prescribed as a treatment for cancer of the *prostate gland,* a male reproductive organ. It is also sometimes used to treat breast cancer in women who have reached the end of their natural childbearing years and in men. Alice S. Sloan

Descartes, *day KAHRT,* **René,** *ruh NAY* (1596-1650), was a French philosopher, mathematician, and scientist. He is often called the father of modern philosophy. Descartes invented analytic geometry and developed a detailed account of the physical universe in terms of matter and motion. He was a pioneer in the attempt to formulate simple, universal laws of motion that govern all physical change.

Descartes wrote three major works. The first was *Discourse on the Method of Rightly Conducting One's Reason, and Seeking Truth in the Sciences* (1637), commonly known as the *Discourse on Method.* The others were *Meditations on First Philosophy* (1641), perhaps his most important work, and *Principles of Philosophy* (1644). His philosophy became known as *Cartesianism.*

His life. Descartes was born at La Haye, near Châtellerault, and was educated at a Jesuit college. He served in the armies of two countries and traveled widely. Money from an inheritance and from patrons enabled him to devote most of his life to study. From 1628 to 1649, he led a quiet, scholarly life in the Netherlands and produced most of his philosophical writings. Late in 1649, he accepted an invitation from Queen Christina to visit Sweden. He became ill there and died in February 1650.

Oil portrait (about 1649) by Frans Hals; the Louvre, Paris (EPA/SCALA)

René Descartes

His philosophy. Descartes is called a *dualist* because he claimed that the world consists of two basic substances—matter and spirit. Matter is the physical universe, of which our bodies are a part. The human mind, or spirit, interacts with the body but can, in principle, exist without it.

Descartes believed that matter could be understood through certain simple concepts he borrowed from geometry, together with his laws of motion. In Descartes's view, the whole world—including its laws and even the truths of mathematics—was created by God, on whose power everything depends. Descartes thought of God as resembling the human mind in that both God and the mind think but have no physical being. But he believed God is unlike the mind in that God is infinite and does not depend for His existence on some other creator.

In *Meditations on First Philosophy,* Descartes first considered the strongest reasons that might be used to show that he could never be certain of anything. These so-called "skeptical" arguments included the idea that perhaps he might be dreaming, so that nothing he seemed to perceive would be real. In another argument, Descartes reflected that perhaps God or some evil spirit was constantly tricking his mind, causing him to believe what was false. Descartes then responded to these arguments. He began with the observation that even if he were dreaming, or constantly deceived, he could at least be certain that he had thoughts, and therefore existed as a thinking being. This, he wrote, was a "clear and distinct" perception of the mind. Nothing could make him doubt it. In another work, Descartes introduced the famous Latin phrase *cogito ergo sum,* which means *I think, therefore I am.*

Descartes then argued that he could also clearly and distinctly perceive that an infinitely powerful and good God exists. This God would not allow Descartes to be deceived in his clearest perceptions. Through this conception of God, Descartes sought to establish that the physical world exists with the properties the philosopher assumed in his physics. He continued to hold, however, that sensory appearances are often misleading. Margaret D. Wilson

See also **Age of Reason** (The worship of reason); **Philosophy** (Modern philosophy; picture); **Psychology** (Beginnings); **Science.**

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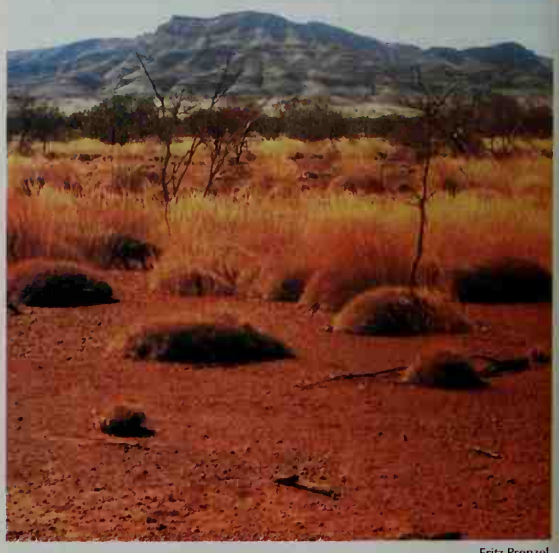
Deseret, *DEHZ uh reht,* is a word meaning *honey bee* in the *Book of Mormon.* The Mormons adopted the honey bee as the symbol of hard work necessary for the success of their Salt Lake Valley settlement. In 1849, they organized the State of Deseret. Congress refused to admit it as a state, and created instead the much smaller Territory of Utah. Dan L. Flores

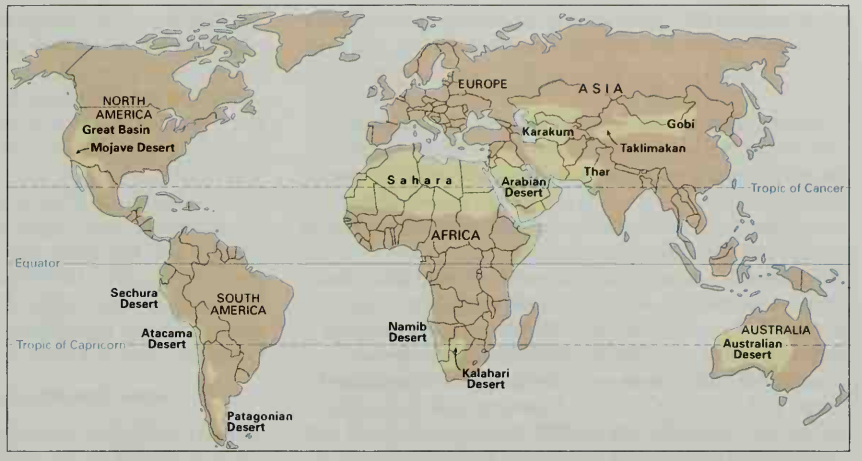
See also **Mormons.**

Desert is generally thought of as a hot, barren region that receives little rainfall. Rainfall is scarce in all desert regions, but deserts are not wastelands. Deserts have



Fritz Prenzel

Deserts have highly varied landscapes. This photograph of the Australian Desert shows some of the different types of plant life and surface features found in desert regions.



Deserts cover about a fifth of the earth's land surface. Most deserts lie near the Tropic of Cancer and the Tropic of Capricorn. These regions are high-pressure zones in which cool air descends. The descending air becomes warm and absorbs moisture instead of releasing it as precipitation. Other deserts are in (1) regions separated from the ocean by mountains and (2) coastal areas.

Desert

WORLD BOOK map

varied landscapes and types of soil, and many deserts have at least one permanent stream. Deserts cannot support the wide variety of plant and animal life found in humid climates. However, many kinds of plants and animals thrive in deserts.

Scientists do not agree on a single definition for deserts. Some classify a desert as any region where the amount of moisture lost each year—mainly by evaporation—exceeds the moisture that falls as precipitation. Other scientists use the type of soil or plant life to determine whether a region is a desert. Others consider all these factors. No matter how it is defined, a desert is a region that can support little plant life because of insufficient moisture and dry soil.

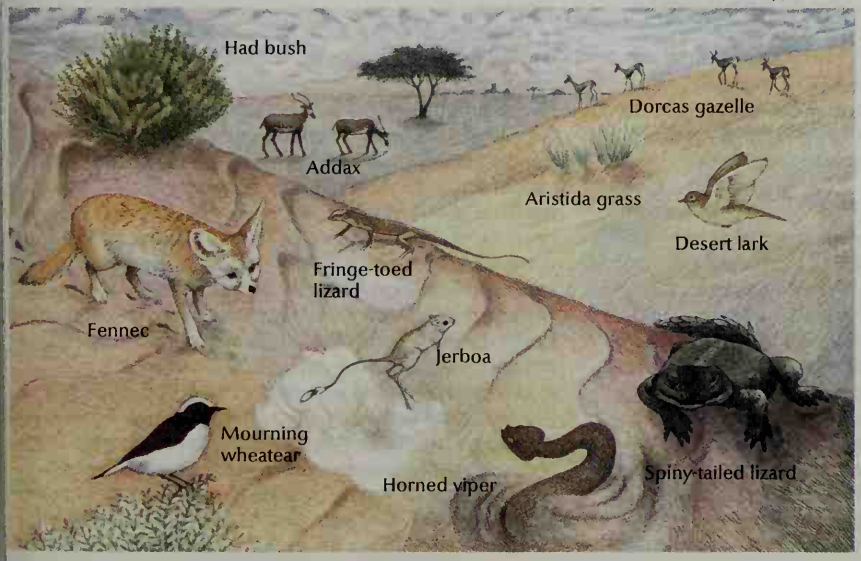
Some regions near the North and South poles are also considered deserts. These areas are so cold that moisture freezes and cannot stimulate plant growth. This article discusses deserts in warm regions.

Deserts cover about a fifth of the earth's land area. The largest desert in the world is the Sahara in northern Africa. The Sahara occupies about 3 $\frac{1}{2}$ million square miles (9 million square kilometers), an area roughly equal to that of the United States. In North America, deserts cover about 500,000 square miles (1.3 million square kilometers).

Deserts cannot support large numbers of people. Residents must adjust to the dry climate. Farming is generally restricted to river valleys or areas where water for irrigation can be obtained from wells or springs. Large areas of some deserts are thinly covered with grass and shrubs and are used for grazing cattle, sheep, and goats. Most towns and cities in deserts obtain water from wells or nearby rivers. Some cities bring in water by canal or pipeline from distant sources. Cities often compete for the limited water available in desert regions.

People who live in deserts must protect themselves from high temperatures in summer and, in some cases, from cold temperatures in winter. In North American deserts, many residents live in adobe or mud houses that provide insulation from the heat and cold. Herders in Africa and Asia live in tents and wrap themselves in long robes for protection against the scorching sun and

WORLD BOOK illustration by Jean Helmer



Many kinds of plants and animals live in desert regions. The illustration at the left shows some plant and animal life of the Sahara. These organisms have developed various ways to survive the extremely hot, dry climate of the desert.

blowing sand. Air conditioning makes life comfortable for many city dwellers in hot desert regions.

Desert land and climate

Sand covers about 10 to 20 per cent of most deserts. The rest of the land consists of gravel-covered plains, rocky hills and mountains, dry lake beds, and dry stream channels. Many desert soils are rich in salt, uranium, and other minerals. In addition, large deposits of oil and natural gas lie under some deserts.

A desert landscape includes various kinds of surface features created by water and wind erosion and by deposits of silt, sand, and other *sediments.* The drainage system is made up of normally dry streams. These streams are called *arroyos* in the Southwestern United States and northern Mexico. After a rainfall, water fills the stream channels. The rapidly flowing water cuts away the rocks of desert mountains and carries sediments to the mouth of mountain canyons. There, deposits of sediments create fan-shaped forms known as *alluvial fans.* Sometimes, the streams carry water into low areas in the desert plains and form temporary lakes. The water that collects in these lakes either evaporates or seeps into the ground. Water erosion also creates big flat-topped hills known as *mesas* and smaller flat-topped hills called *buttes.* Parts of deserts are covered by mounds and ridges of windblown sand called *dunes.* Vast regions covered by sand and dunes are called *sand seas.* Sand seas cover large areas in desert regions of Africa, Asia, and Australia.

An *oasis* is a fertile area in the desert where underground water comes close enough to the surface for wells and springs to exist. Oases occur throughout a desert and serve as sites for settlement and irrigated farming. Streams that contain water the year around flow through many deserts. Their water comes from streams that begin in mountains outside the desert.

Most deserts average less than 10 inches (25 centimeters) of precipitation each year, but the amount of precipitation may vary greatly from year to year. A desert may receive no rainfall for several years, but large amounts of rain might fall within a few hours.

Deserts include the hottest places in the world because they absorb more heat from the sun than does land in humid climates. In summer, desert temperatures often reach 100 °F (38 °C) or higher during the day. At night, however, temperatures may drop to 45 °F (7 °C) or lower. Many deserts have mild winters, but some have freezing temperatures and snow in winter.

Life in a desert

Desert plants tend to be widely scattered. The plants that survive compete for the small amount of water available, and so they cannot grow close together.

Some desert plants obtain water from deep beneath the ground surface. For example, the mesquite tree has roots that extend as deep as 263 feet (81 meters). Other plants store large amounts of water in their leaves, roots, or stems. The stem of a barrel cactus swells with water after a rainfall and shrinks as the plant uses the water. Other plants survive by reducing their water loss. Most of this loss occurs through the leaves, and so some plants shed their leaves in dry periods.

After a rainfall, colorful flowers cover parts of a desert. This dramatic change occurs because many desert plants do not grow in dry periods. After a rainfall, these plants quickly sprout, flower, and die.

Desert animals include many kinds of insects, spiders, reptiles, birds, and mammals. Deer, foxes, wolves, and other animals may visit a desert after a rainfall in search of food. Most desert animals avoid the extreme midday heat by feeding at night after the temperature has dropped. Many small animals dig burrows underground and stay there during the day. Some of them are *dormant* (inactive) in the summer. Larger desert animals try to stay in shady areas during the day. They obtain water from the food they eat and from the few water holes that exist in a desert.

How deserts develop and change

Most deserts lie between the latitudes of 15° and 35° on each side of the earth's equator. These latitudes are in zones of high atmospheric pressure—that is, areas in which cool air descends and becomes warm. These high pressure zones are created by the way the air moves over the earth. At the equator where temperatures are high, air becomes warm and rises. As the air rises, it cools and releases moisture over regions near the equator. In time, the air descends over areas that extend between 15° and 35° both north and south of the equator. As it descends, it becomes warm and dry. This warm air causes desert conditions. The Sahara and several other great deserts lie in this region.

Regions separated from an ocean by mountains also tend to be dry. A moist wind blowing inland from an ocean loses its moisture as it rises over mountains and becomes cool. As the wind descends on the side of the mountains facing land, it becomes warm and dry. This warm air creates a *rain shadow,* or dry area. The North American deserts developed partly because of the rain-shadow effect.

Cold ocean currents flowing next to a continent can cause deserts to form in areas along the coast. Deserts form because the cool winds that blow across the cold water and onto the land can carry little moisture. The Atacama Desert in South America is an example of such a desert.

A change in climate can cause changes in the location and extent of deserts. During the last few thousand years, many deserts have formed as the world's climate has changed from cool and wet to warm and dry. Human activities have also caused desert regions to expand. This expansion occurs because of the continual loss of fertile land on the outskirts of deserts. This loss occurs chiefly from *overgrazing*—that is, from so much grazing by livestock that plant life is destroyed. Without the protective cover of plant life, wind and water increase soil erosion. This change of fertile land into a desert is called *desertification.* Other activities that cause desert expansion include mining, improper farming methods, and destruction of trees.

Desertification is a serious problem because the loss of productive land can lead to famine. Some steps have been taken to prevent further desertification and to reclaim some of the barren land. For example, trees have been planted in certain desert areas to reduce the wind at ground level. This procedure prevents sand from being blown onto the crops. Scientists believe that im-

proving farming methods and limiting the amount of livestock in areas close to deserts will also help check desert expansion. Wayne Lambert

Related articles in *World Book* include:

Deserts

Arabian Desert
Atacama Desert
Australian Desert
Colorado Desert
Death Valley
Gobi
Great Basin
Great Salt Lake Desert
Great Victoria Desert
Kalahari Desert
Karakum
Kyzylkum
Mojave Desert
Negev
Painted Desert
Sahara
Sahel
Syrian Desert
Thar Desert

Desert animal life

Animal (Animals of the deserts)
Camel
Chuckwalla
Courser
Dromedary
Horned lizard
Kangaroo rat
Lizard
Tortoise

Desert plant life

Cactus
Century plant
Creosote bush
Date palm
Flower (pictures: Flowers of the desert)
Mesquite
Plant (Where plants live)
Sagebrush
Saguaro
Succulent

Other related articles

Arabs
Basin
Bedouins
Butte
Caravan
Climate
Dune
Irrigation
Mesa
Mirage
Nomad
Oasis
Rain
Sand
Sandstorm
World (graph: Largest desert on each continent)

Additional resources

Level I

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Savage, Stephen. *Animals of the Desert.* Raintree Steck-Vaughn, 1997.

Level II

Alloway, David. *Desert Survival Skills.* Univ. of Tex. Pr., 2000.
Mares, Michael A., ed. *Encyclopedia of Deserts.* Univ. of Okla. Pr., 1999.

Desert Storm. See Persian Gulf War.

Desertion is the military crime of running away from a military unit, organization, or place of duty with the intention of staying away permanently. Leaving the armed forces for only a short time to avoid hazardous duty or important work is also desertion. During wartime, deserters may be punished by death. Someone who runs away from military service but intends to return is not a deserter. That person is guilty of the military crime of being absent without leave (AWOL).

Desertion occurs in civil law when a married person intentionally leaves his or her spouse, and stays away for a certain length of time without consent or adequate reason. In many states in the United States, desertion is a ground for divorce. A person who forces the spouse to run away by making their home unsafe or unbearable may also be treated as a deserter. Robert C. Mueller

See also **Abandonment**.

De Seversky, *duh suh VEHR skee,* **Alexander Procofieff,** *pruh KAWF yuhf* (1894-1974), was a pilot, aircraft designer, and military authority. His fighter plane designs were among the most advanced of the 1930's. He invented an automatic bombsight, amphibian landing gear, and hydraulic shock absorbers for aircraft. De Seversky's theories about the use of air power drew wide attention.

De Seversky was born in Tbilisi, Georgia, then part of Russia. He received his education at Russia's Imperial Naval Academy. De Seversky lost a leg in aerial combat during World War I (1914-1918). He came to the United States in 1918, after the Russian Revolution, and became a citizen of the United States in 1927. De Seversky established an aircraft manufacturing firm in the United States. Roger E. Bilstein

De Sica, *duh SEE kuh,* **Vittorio,** *vih TOHR ee OH* (1902-1974), was an Italian motion-picture director and actor. He became noted for his realistic portrayals of life among the poor.

De Sica's best films include *Shoeshine* (1946), about war orphans, and *The Bicycle Thieves* (1948), about postwar unemployment. In these and other motion pictures, he presented a grim view of life. De Sica's films won critical acclaim, but the hopelessness they implied became unpopular with audiences. After *Umberto D* (1952), De Sica found it difficult to find backing for the type of film he wanted to make.

De Sica was born in Sora, Italy. A popular actor, he turned to directing in 1939 and had his first success with *The Children Are Watching* (1942). His other films include *Miracle in Milan* (1951), *Two Women* (1961), *Marriage, Italian Style* (1964), and *The Garden of the Finzi-Continis* (1971). Gene D. Phillips

See also **Motion picture** (Postwar realism; picture: Italian films).

Design is the organized arrangement of materials to satisfy a functional or artistic purpose. Design plays an important role in all the fine arts and in the creation of industrial products.

Visual artists or designers work with such elements of design as *line, plane, texture, color, shape, form, volume, mass,* and *space.* When these elements are combined in a satisfying manner, the design will have an interesting variety within an overall unity.

Repetition consists of repeated lines or shapes. Japanese color prints are noted for their handling of repetition. Many of them have fine slanting lines of rain, or scenes with reflections on water repeated over and over.

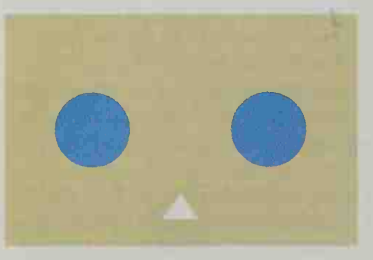
Harmony, or *balance,* can be obtained in many ways in design. It may be *symmetrical* (in balance). It may also be *asymmetrical* (out of perfect balance) but still pleasing to the eye. A small area may balance a large area if the small area has an importance to the eye that equals that of the larger area.

Contrast is the opposite of harmony. It involves such relationships as *large* and *small, thick* and *thin, dark* and *light, dense* and *sparse,* and *scattered* and *concentrated.*

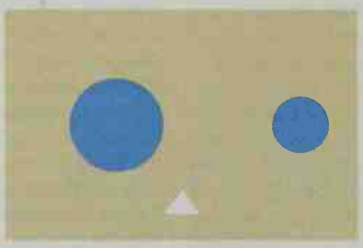
Rhythm and movement are obtained either by using wavy lines or by placing motifs in contrast to *static* (set) patterns. This technique adds interest to a design.

Unity occurs when all the elements in a design combine to form a consistent whole. A design has unity if its

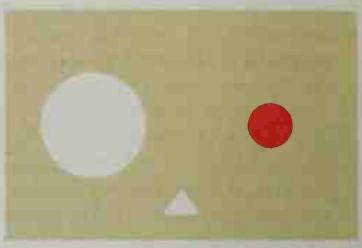
Some principles of design



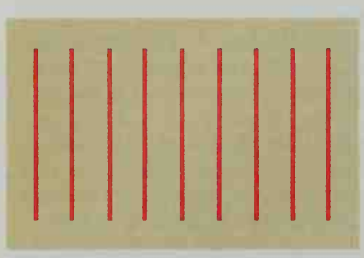
Symmetrical balance is achieved if identical shapes are placed an equal distance from the center of a composition.



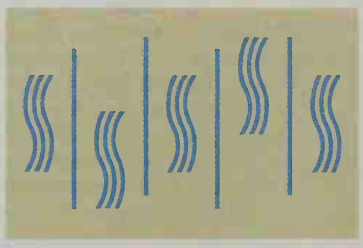
Asymmetrical balance results if the larger of two objects is placed closer to the center than the smaller one.



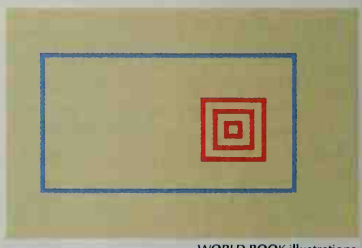
Visual balance is created if a small, bright form is placed opposite a larger but less colorful form.



Repetition of lines, shapes, and colors can help produce an overall appearance of harmony in a composition.



Rhythm provides variety. The repetition of straight and wavy lines gives this design rhythm and a sense of movement.



WORLD BOOK illustrations

Unity is a satisfying overall effect. Asymmetrical balance, repetition, and harmonious colors help unify this design.

masses are balanced or if its tones and colors harmonize. S. Lee Mann

Related articles in *World Book* include:

Airplane
Architecture
Automobile (Development of the concept)
Clothing (Ready-to-wear clothes)
Drawing
Engineering
Fashion
Furniture
Geometric style
Industrial arts
Industrial design
Interior design
Moiré pattern
Opera (The designers)
Painting
Sculpture
Theater (Scene design)

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Lawson, Bryan. *How Designers Think.* 3rd ed. Butterworth Architecture, 1997.

Design, Interior. See Interior design.

De Sitter, *duh SIHT uhr,* **Willem,** *WIHL uhm* (1872-1934), was a noted Dutch astronomer. He began his career studying celestial mechanics. Early in his career, De Sitter determined the masses of Jupiter's moons. He is best known for his realization that Einstein's general relativity theory might apply to cosmology.

In 1917, De Sitter pointed out that if the universe's density were low enough, the universe would be expanding at nearly the speed of light. His proposal gained in credibility when American astronomer Edwin Hubble later observed that the farther away distant galaxies are, the faster they seem to be receding. De Sitter was born on May 6, 1872, in Sneek in the Netherlands.

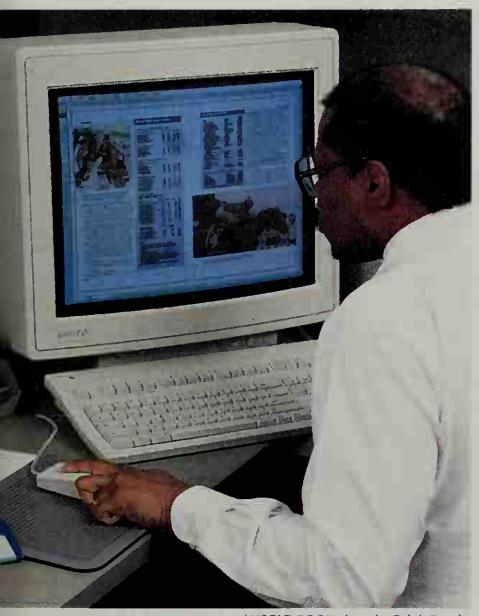
Karl Hufbauer

Desktop publishing is the use of a personal computer to write, illustrate, and lay out high-quality documents. Publications produced by means of desktop systems range in complexity from simple newsletters that are printed in black and white to magazines and books that are illustrated in full color. In general, the term *desktop publishing* is used in relation to printed materials. For information on the distribution of publications in *digital* (numerical) form over the Internet or via such media as CD-ROM (Compact Disc Read-Only Memory), see **Electronic publishing.**

Desktop publishing, often referred to as DTP, began in the mid-1980's. It gradually replaced older methods in which skilled professionals or even separate companies perform various tasks using specialized equipment. These tasks include writing and editing, design and illustration, typesetting, and the preparation of type and *graphics* (illustrations) for printing.

A basic DTP system consists of a personal computer, a *scanner,* special software, and a *high-resolution* laser or inkjet printer. A scanner is a device that converts photographs and other illustrations to digital images. The software usually includes a word-processing program for writing and editing, a design program to create graphics and to manipulate scanned graphics, and a page-layout program. The layout program is used to set the number and size of published pages, design the layout of the page elements, typeset the text, and position the graphics. Finished documents, in the form of digital computer files, are ready for printout on a computer printer. A high-resolution printer is one that can print fine details. People can also use digital files produced by desktop publishing to prepare film images of text and graphics for reproduction by printing presses.

Three technological breakthroughs in the mid-1980's created the field of desktop publishing: (1) the Apple Macintosh personal computer, developed by Apple Computer, Incorporated, (2) Apple's LaserWriter printer, and (3) PostScript, a programming language used for printing out professional-level type and graphics devel-



WORLD BOOK photo by Ralph Brunke

WORLD BOOK photo

Desktop publishing software enables people to use computers to edit and design publications. This artist is designing two pages of a book by positioning images of the text and illustrations. Data created during this process can be used to print the actual pages in the book, *shown here.*

oped by Adobe Systems, Incorporated. A person using this relatively inexpensive equipment could produce high-quality publications quickly.

Graphic design firms and advertising agencies were among the first to recognize that DTP could save time and money. As DTP systems became more powerful and the cost of equipment decreased, commercial printers and publishers began to use them. Today, a vast majority of printed materials are created with desktop publishing systems. Anne-Marie Concepción

De Smet, *duh SMEHT,* **Pierre Jean** (1801-1873), was a Roman Catholic missionary who worked in the American West. His success as a missionary and as a peacemaker between American Indians and white settlers became legendary. De Smet argued that just and honest treatment of Indians was the surest way to keep peace with them.

De Smet was born on Jan. 30, 1801, in Termonde, also called Dendermonde, Belgium. He came to the United States in 1821 and became a Jesuit priest in 1827. In 1841, he founded St. Mary's Mission among the Flathead Indians near present-day Missoula, Montana. He later started other Indian missions in the Rocky Mountains and Oregon. He also worked to gain support for missions.

The U.S. government often used De Smet to negotiate with Indians angered by the coming of white settlers. In 1851, he took part in a treaty council at Fort Laramie, Wyoming. This council agreed to reserve lands for the Plains tribes. In 1868, he negotiated a temporary peace with Chief Sitting Bull, whose Sioux warriors had vowed to kill the next white person they saw. De Smet wrote several books about Indian life and mission work. They are important sources for historians. James A. De Jong

Des Moines, *duh MOYN* (pop. 198,682; met. area pop. 456,022), is the capital, largest city, and chief industrial center of Iowa. It is also the county seat of Polk County. The city is in south-central Iowa, where the Des Moines and Raccoon rivers meet (see **Iowa** [political map]).

The city takes its name from the Des Moines River. Many historians believe the river's name came from Indians who built mounds in the area and called the river *Moingona* (river of the mounds). Some historians believe that the name comes from the French word *moines* (monks), after a group of Trappist Monks who lived near the mouth of the river.

Description. Des Moines covers 78 square miles (202 square kilometers). The golden-domed State Capitol overlooks the city's downtown from the east. Downtown Des Moines is the site of Iowa's tallest building, called 801 Grand. The building rises 630 feet (192 meters).

The city's attractions include the Des Moines Art Center; the Civic Center; the Convention Center; the Science Center of Iowa; the State Historical Museum; Terrace Hill, the governor's mansion; and Living History Farms, a collection of working farms that demonstrate the history

Des Moines Civic Center

Des Moines Civic Center is a performance hall where such events as dance recitals, concerts, and plays are presented. *Crusoe Umbrella,* a huge sculpture by the American artist Claes Oldenburg, stands at the left.

of agriculture. The Iowa State Fair, held in Des Moines, draws many visitors to the city each August.

Des Moines is the home of Drake University, Des Moines University - Osteopathic Medical Center, and Grand View College. It also has a community college and several business colleges.

Economy. Des Moines is Iowa's main commercial center and one of the largest insurance centers in the world. More than 50 insurance companies have their headquarters in Des Moines. State government and the health care industry are other leading employers. There are also about 400 manufacturing plants in the area. Food processing is a leading industrial activity. Other industries produce fabricated metal goods, farm machinery, plastics and rubber products, and printed materials. Many exporting and importing firms operate in the area. Several freight railroads and the Des Moines International Airport serve the city.

Government and history. Des Moines has a council-manager form of government. The council consists of seven members, including the mayor, all of whom serve four-year terms. The voters of the entire city elect the mayor and two other council members. The other members are elected from the city's various wards. The council hires a city manager to carry out its policies.

The Sauk and Fox Indians lived in the area before white settlers arrived. In 1843, the United States Army established a post where the city now lies. The Army built Fort Des Moines at the site, on land purchased from the Indians. By 1845, the Indians had given up their rights to the region. In 1853, the settlement surrounding the fort was incorporated as the town of Fort Des Moines. The word *Fort* was dropped from the name in 1857. That same year, the Iowa legislature chose Des Moines as the state capital because of its central location within Iowa. Des Moines grew rapidly after it became the capital. Its population jumped from 3,965 in 1860 to 50,093 in 1890.

Des Moines later developed as a military training center. In 1898, during the Spanish-American War, the city had a National Guard camp. In 1902, a cavalry post called Fort Des Moines was established there. It served as a training camp during World War I (1914-1918) and World War II (1939-1945). The Women's Army Corps (WAC) was founded there in 1942, and Fort Des Moines was its training center through the end of World War II.

The population of Des Moines declined during the 1960's as large numbers of people moved to the suburbs. Business in the city's downtown area suffered as a result. In the early 1980's, Des Moines renovated its central business district. Major construction projects included new office skyscrapers, shopping malls, housing complexes, and convention and entertainment centers. Glass-enclosed elevated walkways called *skywalks* were built to connect most major buildings.

By the beginning of the 2000's, about 3 miles (5 kilometers) of skywalks linked buildings in the downtown area. Plans for further downtown development called for office buildings, educational centers, and entertainment districts to be completed by 2004. Randy Essex

For the monthly weather in Des Moines, see **Iowa** (Climate). See also **Iowa** (pictures).

De Soto, *dih SOH toh,* **Hernando** (1500?-1542), a Spanish explorer, helped to defeat the Inca empire and led the first European expedition to reach the Mississippi River. From 1539 to 1542, he led a large Spanish expedition through what is now the southern United States. His army landed in Florida and crossed about 10 present-day states.

De Soto became known as a courageous explorer who helped conquer the New World for Spain. However, the era of exploration was marked by greed, intolerance, and cruelty. In their search for wealth, de Soto and his men tortured and brutally killed many Indians.

Early expeditions. De Soto was born in the province of Extremadura in Spain. As a teen-ager, he sailed to the New World and began his career as an explorer in the tropical rain forests of Panama. De Soto served in expeditions to enslave Indians and to search for wealth.

By the early 1530's, de Soto was known as an excellent soldier and horseman. He joined an expedition led by Francisco Pizarro, another Spanish explorer, against the empire of the Inca Indians in what is now Peru. After a short delay, the men began their journey in 1532 with a small army of 168 men. They reached the city of Cajamarca, where a huge Inca army, commanded by Emperor Atahualpa, was camped.

Pizarro sent de Soto with a small troop of 15 cavalrymen to invite Atahualpa to meet with Pizarro. The Spaniards ambushed the Inca and captured their emperor. Although the Inca paid an enormous ransom for their emperor, the Spaniards executed him. De Soto helped Pizarro capture Cusco, the Inca's capital, in 1533.

In 1536, de Soto returned to Spain a rich man from treasures collected during the Inca conquest. He could have led a noble lifestyle, but he sought his own command in the New World. King Charles I of Spain appointed him governor of Cuba and authorized him to conquer and colonize the region that is now the southeastern United States.

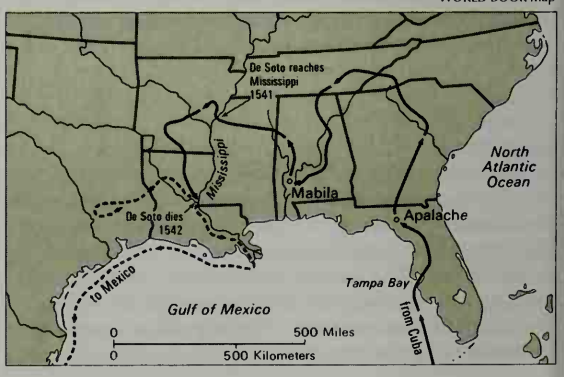
Journey to the Mississippi. De Soto arrived near present-day Tampa Bay in 1539. He brought more than 600 men equipped with horses to help him colonize the land and search for gold. De Soto planned to capture In-

De Soto's expedition 1539-1543

This map shows Hernando de Soto's explorations in the American Southeast. While searching for gold, he found the Mississippi River. He died in 1542, and Luis de Moscoso completed the journey in 1543.

Route of De Soto
Route of De Moscoso
Indian village

WORLD BOOK map



United States Capitol Historical Society, Washington, D.C.

Hernando De Soto arrived at the Mississippi River on May 8, 1541. William H. Powell's painting *Discovery of the Mississippi* shows De Soto and his group approaching the river's edge.

dian chiefs, take hundreds of Indians as ransom, and march through their territories.

The army camped for the winter in what is now northern Florida, possibly in Tallahassee, and headed north during the spring and summer of 1540. They traveled through the present-day states of Georgia and the Carolinas, crossed the Great Smoky Mountains, and headed south through the Georgia and Alabama area. In October 1540, followers of the Choctaw leader Tuscaloosa ambushed de Soto's army at the town of Mabila, south of present-day Montgomery, Alabama. Despite emerging victorious, de Soto's army retreated northward. The men then traveled through the Mississippi area, crossed the Mississippi River, and explored the Arkansas region and other present-day states west of the river.

On May 21, 1542, de Soto died from a fever by the banks of the Mississippi River. The remains of his army, led by Luis de Moscoso, reached New Spain (now Mexico) the next year. Lawrence A. Clayton

Additional resources

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Despotism, *DEHS puh tihz uhm,* is a form of government in which the ruler has unlimited power over the people. Despots are not necessarily harsh or cruel. They may be kindly and considerate, and they may even put the welfare of the people above their own wishes. But usually, despots do not feel bound by the preferences of their subjects, and they sometimes use force to maintain their power.

The late 1700's are often called the Age of the Enlightened Despots. During this period, Frederick the Great of Prussia, Catherine the Great of Russia, and Joseph II of the Holy Roman Empire did their best to reform the laws, to promote education and the arts, and to conduct the affairs of the country efficiently. Charles III of Spain, Leopold of Tuscany, Joseph of Portugal, and Gustav III of Sweden also deserved the name of "enlightened despots." Some of these rulers learned that freedom and education make rebellious subjects and gave up enlightenment. Nearly all were followed by rulers who undid whatever good the "enlightened despots" had accomplished. Alexander J. Groth

See also **Catherine the Great; Frederick II** (of Prussia).

Desprez, *duh PRAY* or *day PRAY,* **Josquin,** *ZHUHS kan* or *zhaws KAN* (1440?-1521), was one of the greatest composers of the Renaissance period. He has been highly praised for his ability to express words through music. He was also known for his command of musical techniques, especially his skillful use of the *canon,* a musical device in which the melody is repeated in one or more other parts. Josquin usually wrote music for four voices. Many of his pieces are love songs. For the church he wrote about 100 unaccompanied choral works known as *motets* and 18 Masses. Beginning in 1502, several of the earliest books of printed music were devoted to his works. Many pieces by lesser composers were attributed to him.

Josquin was born in northern France but lived in Italy for many years. He was a singer at Milan Cathedral and at the Papal Chapel in Rome. He also served the dukes of Milan and Ferrara. After his death, Josquin's music was long neglected, but it is widely admired today. Other spellings of his name include *Deprés* and *Des Prés.*

Joscelyn Godwin

Dessalines, *DAY SA LEEN,* **Jean-Jacques,** *zhahn zhahk* (1758-1806), is one of Haiti's national heroes. He helped free the country from French rule and became its first chief of state.

Dessalines was born in slavery at Grande-Rivière-du-Nord, in what is now Haiti. He served as an officer in the French army. In 1791, he joined a movement for freedom by slaves in the French colony of Saint Domingue (now Haiti). The movement helped lead to the abolition of slavery there in 1793. Then he fought under General Toussaint L'Ouverture against the British and the Span-

ish, who tried to take Saint Domingue from France. Dessalines became a general. He later fought under Toussaint in a revolution against French rule. In 1802, the French arrested Toussaint. Dessalines then became the revolution's leader. In 1804, he declared the colony the independent country of Haiti and assumed the title of governor general for life. He soon proclaimed himself emperor. He was murdered by rivals in 1806.

Patrick Bellegarde-Smith

See also **Toussaint L'Ouverture.**

Destouches, Henri-Louis. See **Céline, Louis-Ferdinand.**

Destroyer is a major warship found in the larger navies of the world. Navies use destroyers chiefly to defend larger warships and amphibious and merchant ships from enemy attack. Destroyers also bombard enemy shores, participate in searches and rescues at sea, and support amphibious landings.

A destroyer measures about 375 to 560 feet (112 $\frac{1}{2}$ to 171 meters) long. Sailors in the United States Navy call destroyers "tin cans" because they have light steel hulls with no armor plating. Destroyers can travel up to 30 *knots* (nautical miles per hour). At 20 knots, the ships can go 6,000 miles (9,700 kilometers) without refueling. Modern destroyers have gas turbine engines.

Destroyers use radar, sonar, and special electronic equipment to detect enemy aircraft, surface ships, and submarines. They use helicopters as their primary antisubmarine weapon. But they also fire rockets and torpedoes against submarines. All U.S. destroyers have at least one 5-inch (127-millimeter) gun that fires against air, land, or sea targets.

The United States Navy has several classes of destroyers, including the *Charles F. Adams, Coontz, Kidd,* and *Spruance* classes. The *Spruance* destroyers are used primarily for antisubmarine warfare. Each destroyer can carry two large antisubmarine helicopters. The *Charles F. Adams, Coontz,* and *Kidd* ships have guided missiles for use against missiles and planes.

In the 1980's, the Navy began building a class of destroyers called *Arleigh Burke.* These destroyers are guided missile ships with a special electronics and weapon control system known as AEGIS.

During World War II (1939-1945), the Navy built smaller ships called *destroyer escorts.* The Navy no longer uses these ships, but some serve in other navies. Destroyer escorts built after the war are called *frigates.*

Norman Polmar

See also **Frigate; Warship.**

David R. Frazier

Destroyers are used chiefly to defend larger warships. The U.S.S. *Elliott, above,* is in the *Spruance* class of U.S. Navy destroyers. The U.S. Navy has several classes of destroyers.

De Sucre, Antonio J. See **Sucre, A. José de.**

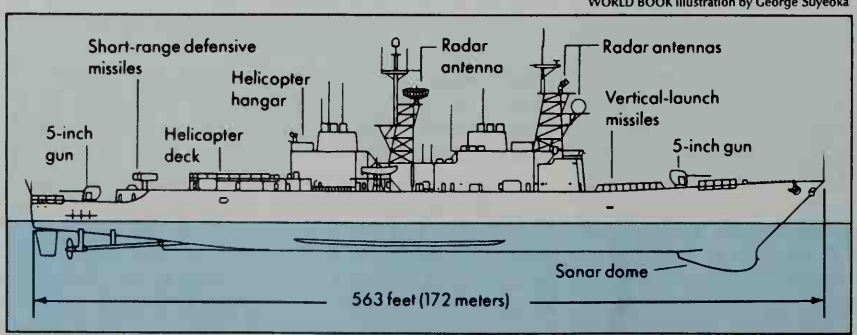
Detective story is a work of fiction about a puzzling crime, a number of clues, and a detective who solves the mystery. In most detective stories, the crime is murder and the clues lead to or away from the solution.

The pattern of most detective stories is the same, whether the tale is a novel, a novelette, or a short story. The author presents the crime, the detective, and several clues and suspects. The detective follows the clues and may even discover additional crimes. The climax of the story comes when the detective reveals the criminal and tells how the mystery was solved.

Certain conventions have developed from the detective story pattern. The author is expected to "play fair" with the reader. That is, the reader should be given exactly the same information that the detective uses to find the criminal. Readers can treat the story as a battle of wits between themselves and the detective.

The detective in most of these stories is not a professional police officer but a private consultant. For exam-

WORLD BOOK illustration by George Suyeoka



***Spruance* class destroyers** of the United States Navy are used mainly for antisubmarine warfare. A *Spruance* destroyer is shown in the diagram at the left.

ple, G. K. Chesterton's Father Brown is a priest, Rex Stout's Nero Wolfe is a gourmet and intellectual, and S. S. Van Dine's Philo Vance is a sophisticated socialite. Fictional professional detectives include Wilkie Collins's Sgt. Cuff, John Creasey's Inspector Gideon (written under the name of J. J. Marric), and Georges Simenon's Inspector Maigret. Romance or financial gain may be a factor in a detective story, but the main theme is the mystery and its solution.

History of the detective story began with Edgar Allan Poe's "The Murders in the Rue Morgue" (1841). With this story and "The Mystery of Marie Rogêt" and "The Purloined Letter," Poe created the literary tradition of detective fiction. His detective was C. Auguste Dupin, a brilliant amateur who uses logic to solve mysteries.

Charles Dickens tried the new form in *Bleak House* (1852-1853) and in his unfinished novel, *The Mystery of Edwin Drood.* Wilkie Collins's *The Moonstone* (1868) was one of the most important early detective novels. Sherlock Holmes and his comrade, Dr. John Watson, appeared in 1887 in Sir Arthur Conan Doyle's *A Study in Scarlet.* Holmes is the most famous character in detective fiction—and perhaps in all fiction.

The early 1900's were a period of excitement and originality in detective fiction. In *The Singing Bone* (1912), the English author R. Austin Freeman introduced the *inverted* detective story, in which the criminal is known from the beginning. The mystery is whether—and how—the criminal will be uncovered. The American writer Jacques Futrelle created a character called the Thinking Machine, and the Hungarian-born Baroness Orczy introduced the Old Man in the Corner. The period from 1925 to 1935 brought the publication of the first or major works by such masters as Margery Allingham, Nicholas Blake, John Dickson Carr, Dame Agatha Christie, Erle Stanley Gardner, Dashiell Hammett, Michael Innes, Msgr. Ronald Knox, Ngaio Marsh, Ellery Queen, Dorothy Sayers, Georges Simenon, Rex Stout, and S. S. Van Dine.

In the 1920's, *Black Mask* magazine introduced a distinctly American style of mystery, often called "private eye" or "hard-boiled" mysteries. These stories focused on a tough detective hero and featured action and violence and a colorful narrative style. Dashiell Hammett was the leader of this style in the 1920's, followed a decade later by Raymond Chandler. The style continues to enjoy great popularity today.

In the mid- and late 1900's, a new generation of detective-story writers gained popularity. They included the American writers Sue Grafton, Tony Hillerman, Emma Lathen, Elmore Leonard, Ross Macdonald, John D. MacDonald, Ed McBain, Walter Mosley, Sara Paretsky, and Robert B. Parker; the English writers Dick Francis, P. D. James, James McClure, and Ruth Rendell; Janwillem Van de Wetering of the Netherlands; and the Swedish team of Maj Sjöwall and Per Wahlöö. David Geherin

Related articles in *World Book* include:

Chandler, Raymond	Francis, Dick	James, P. D.
Chesterton, G. K.	Gardner, Erle Stanley	MacDonald, John D.
Christie, Agatha	Grafton, Sue	Marsh, Ngaio
Collins, Wilkie	Grimes, Martha	McBain, Ed
Cornwell, Patricia	Hammett, Dashiell	Muller, Marcia
Creasey, John	Heyer, Georgette	Orczy, Baroness
Doyle, Arthur Conan	Hillerman, Tony	Paretsky, Sara
	Holmes, Sherlock	Parker, Robert B.
	Queen, Ellery	Poe, Edgar Allan
	Rinehart, Mary R.	Sayers, Dorothy L.
		Simenon, Georges
		Stout, Rex
		Van Dine, S. S.

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Henderson, Lesley, ed. *Twentieth-Century Crime and Mystery Writers.* 3rd ed. St. James Pr., 1991.

Symons, Julian. *Bloody Murder: From the Detective Story to the Crime Novel.* 3rd ed. Mysterious Pr., 1992.

Detergent and soap. A detergent is a substance that cleans soiled surfaces. Soap is a type of detergent. But *detergent* usually refers only to synthetic detergents, which have a different chemical makeup than soap.

Soap and detergent products are made in the form of bars, flakes, *granules* (grains), liquids, and tablets. People use soap to wash their bodies. They shampoo their hair and brush their teeth with soaps and detergents. Doctors clean sores and wounds with soap to kill germs that cause infection.

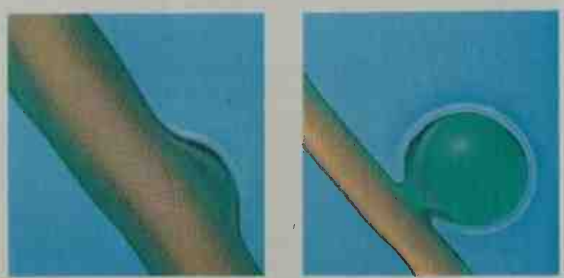
Detergents and soaps have many household and industrial uses. People use these products to wash dishes and laundry, to scrub floors, and to clean windows. Industries use detergents and soaps as cleaners, lubricants, softeners, and polishers. Some motor oils contain detergents that break down soot, dust, and other particles that can harm engine parts. Tire manufacturers apply soap to hot tires to prevent them from sticking to the molds used in *vulcanizing* (hardening) rubber. In addition, soap is used to polish jewelry and to soften leather.

Detergents and soaps contain a basic cleaning agent called a *surfactant* or *surface active agent.* Surfactants consist of molecules that attach themselves to dirt particles in soiled material. The molecules pull these particles out of the material and hold them in the wash water until they are rinsed away.

The chemical industry produces a wide variety of synthetic surfactants, each with a different chemical makeup. There are three main types of synthetic surfactants: those that become positively charged when exposed to water; those that become negatively charged; and those that remain neutral. Nearly all the surfactants used in detergents and soaps become positively charged in water.

Most detergents contain a synthetic surfactant plus other chemicals that may improve a detergent's cleaning ability or make it easier to use. All soaps consist of basically the same kind of surfactant. Detergents and soaps may also contain such ingredients as perfumes, coloring agents, and *germicides* (germ-killing agents).

Detergents have certain advantages over soaps. For example, the most important feature of detergents is



Adapted courtesy of Procter and Gamble (WORLD BOOK illustrations by Paul D. Turnbaugh)

Detergents and soaps clean in much the same way. In the enlarged illustrations, a detergent attacks an oil drop on a strand of cloth, *left.* It pulls the oil out and forms a thin layer around it, *right.* The detergent and oil are then rinsed away.

their ability to clean effectively in *hard water*. Hard water contains certain minerals, and many soaps cannot be used to launder in it. Such soaps react with the minerals to form a substance called *lime soap* or *soap curd*. Lime soap does not dissolve, and so it is difficult to remove from fabrics and other surfaces. It also causes "bathtub ring." Detergents do not leave such deposits, and they also penetrate soiled areas better than soap does. In addition, detergents dissolve more readily in cold water.

How detergents and soap work

Detergents and soaps clean soiled material in much the same way. The cleaning process consists of (1) wetting the soiled material, (2) removing particles of dirt from the material, and (3) *suspending* (holding) the dirt particles in the water until they are rinsed away.

Wetting the material. The surfactants in detergents and soaps increase the wetting ability of water by lowering its *surface tension*. Surface tension holds the water molecules together and causes water to form in drops.

Molecules of surfactant gather at the water's surface and force the water to expand and spread out. With its surface tension reduced, water penetrates the soiled material more completely. Lowering the surface tension also causes surfactants to form bubbles and suds, which do not affect the cleaning ability of the product.

Removing the dirt. The surfactants in detergents and soaps also help remove dirt. A surfactant has two distinct parts with different characteristics. One part of each surfactant molecule is *hydrophilic* (attracted to water), but the other part is *hydrophobic* (repelled by water). The hydrophobic parts of surfactant molecules attach themselves by means of electrical attraction to any surface other than water. Many hold on to and surround the particles of dirt in the soiled material. At the same time, the hydrophilic parts pull away from the material and toward the wash water.

The mechanical *agitation* (motion) of a washing machine, or the movement caused by rubbing by hand, helps break up the dirt. The agitation also helps the hydrophilic parts of the surfactant molecules pull the dirt particles from the material and into the water.

Suspending the particles. After the dirt particles are in the water, the thin layer of surfactant molecules around the particles keeps them separated. These molecules prevent the dirt from settling on the washed material again. The dirt particles remain suspended in the water until they are rinsed away.

How soap is made

The chief ingredients of soap are (1) fats and (2) chemicals called *alkalis*. Manufacturers may use animal fats or such vegetable oils as coconut oil and olive oil. Most soapmakers use sodium hydroxide (often called *lye* or *caustic soda*) as the alkali. Potassium hydroxide is the alkali in liquid soaps and in some bar soaps. Manufacturers use two chief methods to make soap, the *kettle method* and *continuous processing*.

The kettle method. Until the early 1940's, soap companies made most soap in large kettles. Some soap is still made by this kettle method. Manufacturers use steel tanks that stand three stories tall and hold more than 100,000 pounds (45,000 kilograms) of ingredients. Steam that passes through coils in the tanks heats the mixture of fats and alkali for several hours.

The heat triggers a chemical reaction called *hydrolysis* or *saponification*. This reaction causes a creamy soap to form within the mixture. Salt is added to the soap, causing the mixture to separate into two layers. The soap, called *neat soap* at this stage, rises to the top. A solution of excess alkali, salt, and a liquid called *glycerol* remains beneath the layer of soap (see **Glycerol**).

Other ingredients are added in a huge mixer called a *crutcher*. They include perfumes, colors, germicides, and *builders* (substances that help remove dirt). The soap mixture is then hardened into bars or made into flakes or granules.

Continuous processing makes as much soap in a few hours as can be made in several days by the kettle method. In continuous processing, soap manufacturers use a stainless-steel tube called a *hydrolyzer*. The tube measures about 3 feet (90 centimeters) in diameter and about 80 feet (24 meters) in height. Water under high pressure and heated to a temperature of 500 °F (260 °C) is pumped into the top of the hydrolyzer. At the same time, a machine pumps in hot fat at the bottom. The fat splits into fatty acids and glycerol. The fatty acids rise to the top. They are removed from the hydrolyzer, purified, and mixed with alkali to make soap. The soap is then mixed with other ingredients in a crutcher and made into bars, flakes, or granules.

Bar soaps are made for bathing and for laundry use. Manufacturers use several methods to make bars of soap. They make *floating soaps* by mixing the warm soap solution with air in a machine equipped with cooling coils. The machine cools the soap and squeezes it out in the form of a long continuous bar.

In another method, several sets of rollers called *mills* mix and squeeze soap flakes to make *milled soap*. The milling operation produces a hard soap that lathers better than floating soaps.

Modern continuous *finishing machinery* makes soap bars of better quality than those produced by other methods. A machine sprays hot, liquid neat soap into a vacuum chamber, where excess moisture and impurities are removed from the soap. Then the dried soap is cut into the shape of noodles and fed into one or two *kneading units*. Perfume is added to the soap, which comes out of the units in a long bar called a *log*.

Soap made by any of the above methods is cut into small bars of the desired size, called *blanks*. A *press* or *stamper* forms the bars into various shapes and presses the brand name into the finished soap.

Bar soaps used for bathing are usually called *toilet soaps*. These soaps consist entirely of soap or of a mixture of soap and synthetic surfactants. The synthetic surfactants break up lime soap and prevent the formation of bathtub ring and other deposits. *Deodorant toilet soaps* contain a small amount of a germicide.

Granules and flakes. Almost all soap used for home laundering is produced in the form of granules or flakes. Manufacturers make soap granules by pumping warm soap from a crutcher to the top of a tall *drying tower*. The soap is sprayed into a stream of hot air that dries it into bubblelike granules. The granules fall to the bottom of the tower. A filter removes extremely fine particles, and coarse particles are screened out, leaving only granules of about the same size.

Soap flakes are made by pouring soap from a crutcher between two steel rollers, one hot and the other cold. A thin sheet of soap sticks to the cold roller. As the roller turns, the soap is cut into ribbons. A blade scrapes the soap ribbons off the roller. Then the ribbons enter a dryer, where they break or are cut into flakes.

How detergents are made

The manufacture of detergents involves several complicated chemical processes. First, the synthetic surfactant is made in a chemical plant. A variety of substances may be used, including by-products of petroleum, as well as the same vegetable oils and animal fats used to make soap. For example, many manufacturers use beef fat, called *tallow,* in the first step of the process. The tallow is made to react chemically with methyl alcohol. The resulting product is treated with hydrogen gas to produce *hydrogenated tallow alcohol.* This liquid is treated first with sulfuric acid and then with an alkali. The resulting product is a synthetic surfactant.

Other ingredients are mixed with the synthetic surfactant in a crutcher. They include bleaches, builders, fabric brighteners, suds stabilizers, and *antiredeposition agents,* which help prevent removed dirt from returning to cleaned material. The detergent mixture is then processed into granules, flakes, tablets, or a liquid.

Detergent granules and flakes are produced in much the same way as soap granules and flakes. Manufacturers make detergent tablets by adding special ingredients to detergent granules and then pressing the mixture into tablet form. Liquid detergents are made by adding various ingredients to the surfactant so that it remains a liquid at normal temperatures.

History

Early soap. No one knows when or where people first made soap. The ancient Romans may have used soap 3,000 years ago. People in France used a rough soap about A.D. 100. By about 700, soapmaking had become a craft in Italy. Spain was a leading soapmaker by 800, and soapmaking began in England about 1200.

In the late 1700's, Nicolas Leblanc, a French scientist, found that lye could be made from ordinary table salt. Following Leblanc's discovery, soap began to be made and sold at prices that almost everyone could afford.

Many early settlers in North America made their own soap. They poured hot water over wood ashes to make the alkali *potash.* Then they boiled the potash with animal fats in iron kettles to make soap. The soap cleaned well, but much of it was harsh and had a bad odor.

The soap industry in North America began in the early 1800's. Some people collected waste fats from others and made soap in large iron kettles. They poured the soap into large wooden frames for hardening. Then they cut the hardened soap into bars that were sold from door to door. Since the early 1900's, manufacturers have made big improvements in the mildness, color, fragrance, and cleaning ability of soaps.

The development of detergents. Fritz Gunther, a German scientist, is usually credited with developing in 1916 the first synthetic surfactant for use in detergents. Industries used his product, but it was too harsh for household use. In 1933, the first household detergents based on synthetic surfactants were introduced in the United States. The shortage of fats and other chemical raw materials during World War II (1939-1945) slowed the further development of such products. After the war, several soap companies began to produce detergents based on synthetic surfactants. Since then, the detergent industry has developed a variety of detergents for almost every cleaning job.

Before 1965, detergents in sewage sometimes caused surface foam on rivers and streams. Most detergents contained a synthetic surfactant called *alkylbenzene sulfonate* (ABS), which did not break down completely in sewage treatment systems. In 1965, after more than 10

Lever Brothers Company

The manufacture of bars of soap begins by making liquid neat soap, *far left,* from fats and chemicals. The neat soap is dried and then cut into soap noodles, *center.* The noodles are formed into long logs, which are then cut into blanks, *far right,* and pressed into bars of soap.

years of research, the detergent industry developed a surfactant called *linear alkylbenzene sulfonate* (LAS). Bacteria quickly break down LAS molecules, and so detergents that contain LAS do not cause foam.

In the early 1970's, scientists observed that chemicals called *phosphates,* which were used as detergent builders, contributed to water pollution. When phosphates and other chemicals enter rivers and lakes, they overfertilize simple water organisms called *algae.* Overfertilization increases the growth of algae, which causes the oxygen supply in the water to be used up. Fish cannot live in such water, and so they die. Their bodies pollute the rivers and lakes, which also become choked by the algae. See **Eutrophication; Water pollution.**

To help solve the problem, several state and local governments banned the sale of detergents that contained phosphates. Manufacturers reduced the amount of phosphates in many detergents. They also developed several phosphate substitutes, which enabled them to produce phosphate-free detergents. Paul Karr

Determinant, in mathematics, is a single number related to a square *array* (arrangement) of numbers called *elements.* For example, the following array is related to the number 16:

$$\begin{vmatrix} 3 & 1 \\ 2 & 6 \end{vmatrix} = 16$$

You can compute the value of this determinant in three steps. (1) Multiply the upper left element *3* by the lower right element *6: 3 × 6 = 18.* (2) Multiply the lower left element *2* by the upper right element *1: 2 × 1 = 2.* (3) Subtract the product of step 2 from the product of step 1: *18 − 2 = 16.* The word *determinant* is also used for the square array itself.

Mathematicians use determinants primarily to solve *simultaneous linear equations.* These are sets of two or more linear equations in which the *variables* (unknown numbers) can be satisfied by the same values. For an explanation of linear equations, see **Algebra** (Solving linear equations in two variables). Mathematicians also use determinants for solving other kinds of problems, including the calculation of certain areas and volumes.

Using 2 by 2 determinants. The determinant above is a *2 by 2 determinant* because the array has two *rows* (3,1 and 2,6) and two *columns* (3,2 and 1,6). In general, the symbols a_1, b_1, a_2, b_2 can be used to represent the numbers of any 2 by 2 determinant. Using this notation, the value of the determinant is stated as follows:

$$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1 b_2 - a_2 b_1$$

You can use a 2 by 2 determinant to solve simultaneous linear equations involving two variables. Such equations can be written

$$\begin{aligned} a_1 x + b_1 y &= c_1 \\ a_2 x + b_2 y &= c_2 \end{aligned}$$

The letters x and y represent the variables. You can solve these equations for x and y by arranging the numbers and variables as the ratio of two determinants according to the following formulas.

The formula to solve for x is:

$$x = \frac{\begin{vmatrix} c_1 & b_1 \\ c_2 & d_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}} = \frac{c_1 b_2 - c_2 b_1}{a_1 b_2 - a_2 b_1}$$

The formula to solve for y is:

$$y = \frac{\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}} = \frac{a_1 c_2 - a_2 c_1}{a_1 b_2 - a_2 b_1}$$

The same array appears as the denominator in the formulas for both x and y. This array is called the *determinant of the system.* It is made up of the *coefficients* (multipliers) of x and y in the original equation (a_1, a_2, b_1, b_2). The numerator in the formula for x is the determinant of the system with the coefficients of x replaced by the *constants* (numbers without variables) in the original equations (c_1, c_2). Similarly, these constants replace the coefficients of y in the numerator of the formula for y.

The following equations are simultaneous linear equations involving two variables. These equations can be solved using 2 by 2 determinants.

$$\begin{aligned} 3x + 1y &= 5 \\ 2x + 6y &= 14 \end{aligned}$$

To find the value of x, write the equations as the ratio of two determinants following the formula to solve for x. Then compute the value of the determinants as directed in the first paragraph of this article. The result is

$$x = \frac{\begin{vmatrix} 5 & 1 \\ 14 & 6 \end{vmatrix}}{\begin{vmatrix} 3 & 1 \\ 2 & 6 \end{vmatrix}} = \frac{(5 \times 6) - (14 \times 1)}{(3 \times 6) - (2 \times 1)} = \frac{30 - 14}{18 - 2} = \frac{16}{16} = 1$$

You can solve the equations for y in a similar way.

Using higher order determinants. The order of a determinant is the number of rows or columns it has. A 2 by 2 determinant is of the *second* order, a 3 by 3 of the *third,* and so on. Determinants of an order higher than the second appear, for example, in the solution of three or more simultaneous equations.

You can use third order determinants to solve the following three equations simultaneously:

$$\begin{aligned} a_1 x + b_1 y + c_1 z &= d_1 \\ a_2 x + b_2 y + c_2 z &= d_2 \\ a_3 x + b_3 y + c_3 z &= d_3 \end{aligned}$$

The formulas for x, y, and z are similar to the ones used to solve only two equations. The denominator of each formula is the determinant of the system. The numerators are the determinant of the system with the coefficients of x, y, or z replaced by the constants (d_1, d_2, d_3). For example, the formula for x is:

$$x = \frac{\begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}}$$

Third order determinants such as the one above can be computed in several ways. One method is to reduce the determinant to a series of 2 by 2 determinants. With this method, the denominator in the above formula can be reduced as follows:

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1 \begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1 \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$$

In this operation, each 2 by 2 determinant is multiplied by a number that appears in the first row of the 3 by 3 determinant (a_1, b_1, c_1). The 2 by 2 determinants are called *minors* of these first row elements. A minor consists of the elements that remain in the 3 by 3 determinant after the row and column in which the number appears are crossed out.

This series of 2 by 2 determinants is called an *expansion in terms of the minors of the first row.* It consists of the products of the first row elements and their respective minors. The value of the 3 by 3 determinant is computed by alternately adding and subtracting these products.

Determinants of orders higher than the third also can be computed by reducing them to 2 by 2 determinants. Mathematicians use a variety of methods to make the reductions. Jeffrey C. Barnett

Determinism. See Free will; Taine, Hippolyte A.

De Tocqueville, Alexis. See Tocqueville, Alexis de.

Detonator, *DEHT uh NAY tuhr,* is a small metal or plastic capsule that contains an easily explodable charge. It is used to *detonate* (set off) larger explosive charges, such as dynamite, mines, and bombs. It contains a heat-sensitive *priming charge,* such as lead azide, and a *base charge* of some more powerful explosive, such as RDX. Flame from a fuse or heat from an electric wire ignites the priming charge, which ignites the base charge. The base charge explosion sets off the dynamite, mine, or bomb.

Electric detonators need careful handling because many kinds may be set off by a spark of static electricity from the body. Detonators for dynamite are called *blasting caps.* They can cause serious injury and should be handled only by experts. James E. Kennedy

Detroit, *dih TROYT,* is the largest city in Michigan and one of the world's greatest industrial centers. More automobiles are produced in the Detroit area than anywhere else in the United States. Detroit is often called the Automobile Capital of the World or Motor City. Detroit is also a chief U.S. port and transportation center.

Detroit lies on the southeastern border of Michigan, where the Detroit River separates the United States and Canada. The Detroit River, which is actually a strait, connects Lakes Erie and St. Clair. The French word *Detroit* means *strait.*

Antoine de Lamothe Cadillac, a French colonizer, founded Detroit in 1701. Much of the city's early development resulted from fur trading and agriculture. The automobile industry grew rapidly during the 1900's, and Detroit's population boomed. In 1950, Detroit ranked as the 5th largest city in the United States. But during the last half of the 1900's, Detroit, like a number of large U.S. cities, lost many people to the surrounding suburbs. As of the 2000 census, it ranked as the 10th largest U.S. city.

The city

Detroit covers about 138 square miles (357 square kilometers). Downtown Detroit lies along the Detroit River.

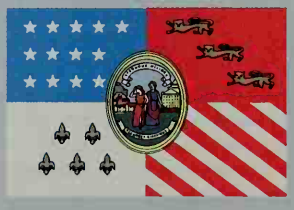
Facts in brief

Population: *City*—951,270. *Metropolitan area*—4,441,551. *Consolidated metropolitan area*—5,456,428.
Area: *City*—138 mi² (357 km²). *Metropolitan area*—3,897 mi² (10,093 km²). *Consolidated metropolitan area*—6,566 mi² (17,006 km²), excluding inland water.
Altitude: 581 ft (177 m) above sea level.
Climate: *Average temperature*—January, 26 °F (−3 °C); July, 73 °F (23 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—31 in (79 cm). For the monthly weather in Detroit, see Michigan (Climate).
Government: Mayor-council. *Terms*—4 years for the mayor and the nine council members.
Founded: 1701. Incorporated as a city in 1815.

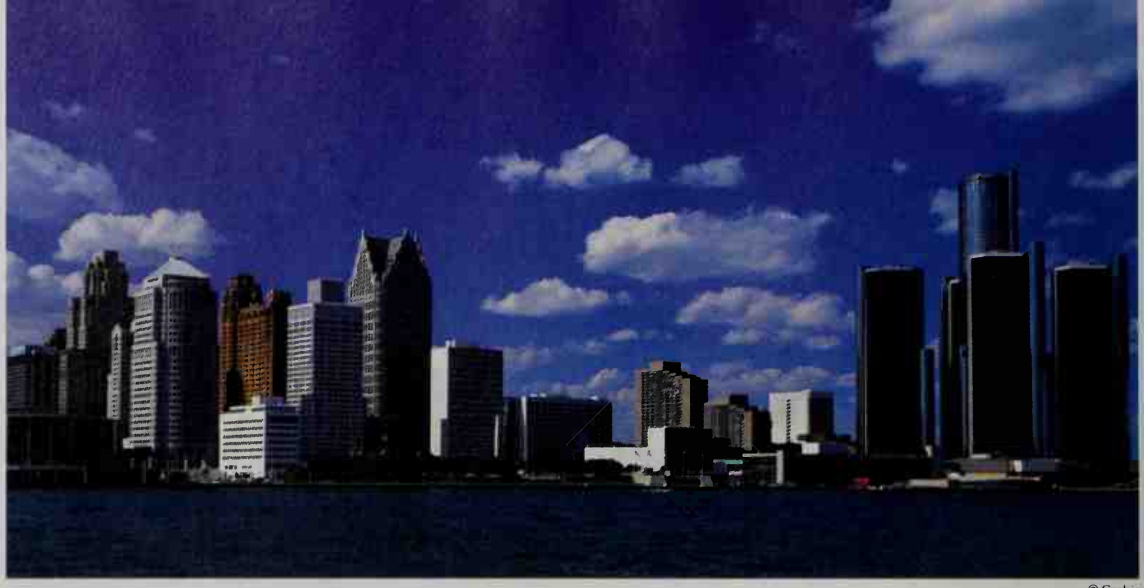
Largest communities in the Detroit area

Name	Population	Name	Population
Detroit	951,270	Clinton*	95,648
Warren	138,247	Westland	86,602
Sterling Heights	124,471	Farmington Hills	82,111
Livonia	100,545	Troy	80,959
Dearborn	97,775	Southfield	78,296

*Unincorporated. Source: 2000 census.



Symbols of Detroit. The city flag shows French fleurs-de-lis, British lions, and American stars and stripes to represent the three nations that have controlled Detroit. The seal symbolizes the Detroit fire of 1805 and the city's rebirth. It bears the city's mottoes, *Speramus Meliora* (We Hope for Better Things) and *Resurget Cineribus* (It Shall Rise Again from the Ashes).



© Corbis

Downtown Detroit stands on the north bank of the Detroit River. The river separates the United States from Canada. Detroit lies across the river from the Canadian city of Windsor, Ontario. Detroit is the largest city in Michigan and one of the world's leading industrial centers.

Because of a bend in the river, Detroit is directly north of the Canadian city of Windsor, Ontario.

Detroit's Civic Center borders the river at the foot of Woodward Avenue. Gardens and a plaza set off its handsome buildings. These structures include the Veterans Memorial Building, a meeting place for veterans and civic groups; the high-rise offices that serve as world headquarters for General Motors Corporation (GM); and the 20-story Coleman A. Young Municipal Center, which houses government offices and courtrooms. Young was Detroit's mayor from 1974 to 1993.

Other buildings in Detroit's Civic Center include the Cobo Conference/Exhibition Center. This center includes the circular Cobo Arena, which can seat about 12,000 people; and Cobo Hall, which has about 700,000 square feet (65,000 square meters) of exhibition space. The arena and hall were named for Albert E. Cobo, who was mayor of Detroit from 1950 to 1957. Near Cobo Arena and Cobo Hall is the Joe Louis Arena, which can seat 19,275. This sports arena was named for heavyweight boxing champion Joe Louis, who grew up in Detroit. The 73-story Westin Hotel in the riverfront GM complex is Detroit's tallest building. It rises 750 feet (229 meters).

Inland from the waterfront, downtown Detroit spreads over more than 40 square blocks. Within this area is Greektown, a district of restaurants, shops, and entertainment spots. Also downtown is the Theater District, which has undergone major restoration. The Fox Theatre, a magnificent movie house built in 1928, reopened in 1988 as a theater for stage shows.

Detroit's residential areas spread outward from downtown. Like many other large industrial cities, Detroit has poor and declining neighborhoods. These areas stand in sharp contrast to the clean, modern, and relatively wealthy suburbs that surround the city.

The metropolitan area covers 3,897 square miles (10,093 square kilometers) in Lapeer, Macomb, Monroe, Oakland, St. Clair, and Wayne counties. About 45 percent of Michigan's people live in this area. Three Detroit suburbs—Livonia, Sterling Heights, and Warren—have more than 100,000 people each. The cities of Hamtramck and Highland Park are entirely surrounded by Detroit. The metropolitan area of Detroit, together with those of the cities of Ann Arbor and Flint, form the Detroit-Ann Arbor-Flint Consolidated Metropolitan Area.

The people

African Americans make up about 80 percent of Detroit's population. Other groups include those of Arab, Canadian, English, German, Hispanic, Irish, Italian, and Polish descent. About half of Hamtramck's people are of Polish ancestry. Many people of Arab ancestry live in metropolitan Detroit, making up the largest Middle Eastern community in the United States.

Economy

Industry. The more than 4,000 factories in the Detroit metropolitan area produce billions of dollars' worth of goods yearly. More than 25 percent of workers in metropolitan Detroit are employed in manufacturing, including more than 10 percent in the auto industry.

Detroit ranks as one of the nation's leading producers of business machines, chemicals, hardware, machine tools, and plumbing fixtures. One of the largest salt mines in the United States lies under the city. This salt mine, which covers nearly 2 square miles (5 square kilometers), contains corridors and large rooms hollowed out of what was once solid salt.

Manufacturing has brought prosperity to Detroit, but the city's many factories have also created problems. For example, Detroit is usually one of the first cities to suffer during major slumps in the nation's economy. A sharp drop in automobile production may also cause hardship for thousands of Detroit workers. In addition, long labor strikes—especially in the automobile industry—can hurt Detroit's economy. The city's many factories also polluted the environment. However, major investments by local industries and municipal governments have greatly reduced air pollution and water pollution in Detroit.

Shipping. Detroit is Michigan's largest port. The city is a gateway for commerce between eastern and western Great Lakes ports. The opening of the St. Lawrence Seaway in 1959 made Detroit an international seaport. The seaway permits oceangoing ships to sail from the

Atlantic Ocean to the Great Lakes. About 20 shipping lines use the Port of Detroit, and over 200 foreign ships dock there annually.

The Detroit River is one of the world's busiest inland waterways. Every year, ships carry over 100 million tons (91 million metric tons) of cargo on the river.

Transportation. The Detroit Metropolitan Wayne County Airport, 18 miles (29 kilometers) west of the city, provides air service for the Detroit area. Railroad passenger trains, freight rail lines, and trucking lines also serve the city. The Detroit People Mover, an elevated rail system, makes a 2.9-mile (4.7-kilometer) loop of Detroit's central business district. The People Mover connects hotels, convention halls, shopping areas, and office buildings. Detroit has more than 75 miles (121 kilometers) of freeways that connect with major highways.

Communication. Detroit's two daily newspapers are the *Detroit Free Press* and *The Detroit News*. Station WWJ, which began broadcasting in Detroit in 1920, was one of the nation's first commercial radio stations.

Education

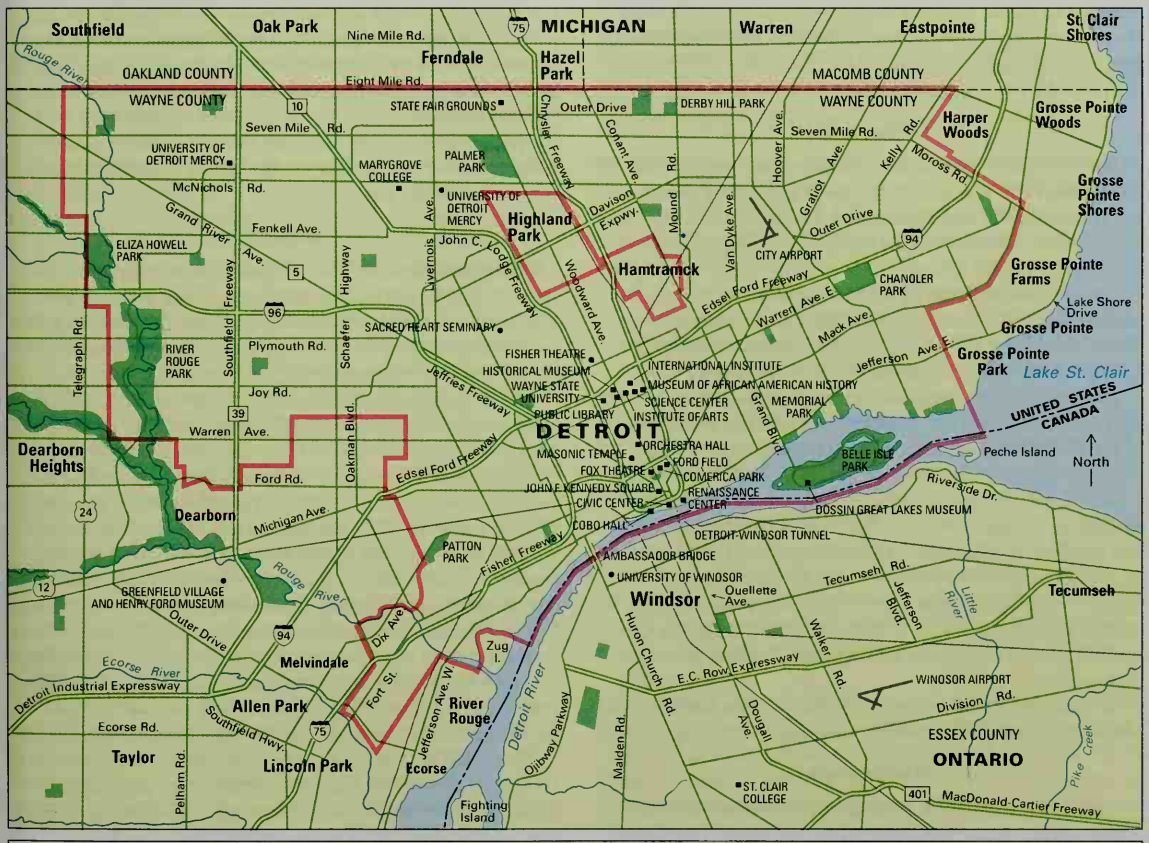
Property taxes and state aid provide the chief sources of income for Detroit's public schools. An 11-member school board heads the city's public school system. The board members are elected to four-year terms. Private and parochial schools serve thousands of students.

Universities and colleges in Detroit include the Col-

Detroit

Detroit lies in southeastern Michigan. The Detroit River separates Detroit from Windsor, Ontario. This map shows the city and major landmarks. The smaller map shows Detroit and the surrounding area.

Park
City boundary
County boundary
International boundary
Expressway
Other street
Railroad
Point of Interest



WORLD BOOK maps

Ford Motor Company

Automobile manufacturing is Detroit's chief industry. Detroit is often called the Automobile Capital of the World or Motor City because it produces more automobiles than any other city.

lege for Creative Studies, Marygrove College, Sacred Heart Seminary College, the University of Detroit Mercy, and Wayne State University. The University of Michigan is in nearby Ann Arbor.

Cultural life

The Detroit Symphony Orchestra presents concerts in Orchestra Hall. The orchestra gives outdoor concerts every summer at Meadowbrook Theater in nearby Oakland County. The Michigan Opera Theatre performs at the Detroit Opera House.

The Detroit Institute of Arts owns a fine collection of sculptures and paintings. Highlights of its collection include murals by the Mexican artist Diego Rivera and paintings by the Dutch artist Vincent van Gogh.

The Detroit Historical Museum has exhibits on the city as it looked during the 1800's. The Children's Museum of the Detroit Public Schools has a bird room and a planetarium. The Museum of African American History is the world's largest institution dedicated to African American culture. The International Institute displays arts and crafts from more than 40 nations. The Detroit Science Center offers science demonstrations and exhibits on the space program. These five museums, together with the Institute of Arts, make up Detroit's Cultural Center. It lies along Woodward Avenue north of downtown.

Another museum in Detroit is the Dossin Great Lakes Museum. It features models of historic ships.

Recreation

Parks. Detroit's park system covers about 6,000 acres (2,400 hectares) and includes over 200 parks, play fields, and playgrounds. The largest park, 1,172-acre (474-hectare) River Rouge Park, has a golf course, swimming pools, and tennis courts. Belle Isle, a 982-acre (397-hectare) park located on an island in the Detroit River, has an aquarium, conservatory, beach, and zoo. The Dossin Great Lakes Museum is in the park. Belle Isle is also the site of the Detroit Grand Prix automobile race. The Detroit Zoological Park covers 122 acres (49 hectares) in Royal Oak. The Michigan State Fair is held every August and September at the State Fairgrounds in Detroit.

Sports. Detroit has a number of professional sports teams. The Detroit Tigers play baseball in the American League. The Detroit Red Wings play in the National Hockey League. The Detroit Pistons compete in the National Basketball Association. The Detroit Lions play in the National Football League.

Other interesting places to visit include:

Cranbrook, in Bloomfield Hills. This 300-acre (120-hectare) educational center includes three private schools, an art museum, and a science institute.

Greenfield Village and Henry Ford Museum, in Dearborn. The village has nearly 100 restored Early American homes, schools, and stores. The museum, next to the village, features the world's largest collection of antique cars.

Government

Detroit has a mayor-council form of government. The people elect the mayor and the nine members of the City Council—all to four-year terms. These elections are nonpartisan—that is, party labels do not appear on the ballots. Detroit's mayor has broad powers. For example, the mayor can veto acts of the City Council and can appoint most key officials, including the police chief. The council is the city's legislative body. It passes laws, holds public hearings, and provides money for city services.

The government's main sources of revenue are a property tax and a city income tax. The income tax applies to all Detroit residents, as well as to suburbanites who work in the city.

History

Early settlement. The Wyandot Indians lived in the Detroit region before the first Europeans arrived. In 1701, French settlers led by Antoine de Lamothe Cadillac built Fort Pontchartrain on the north bank of the Detroit River. The fort became a major fur-trading post.

The British gained control of the fort in 1760, during the French and Indian War. Pontiac, an Ottawa chief, led an Indian attack on the fort in 1763 but he could not capture it (see **Pontiac**). The British began to build Fort Lernoult on the site in 1778, during the Revolutionary War in America. The war ended in 1783, but the British wanted to keep their valuable fur trade in the Michigan region and refused to surrender Fort Lernoult until 1796. Lieutenant Colonel John Francis Hamtramck became the fort's first American commander. Also in 1796, the surrounding area was named Wayne County, and Detroit became the county seat. The county was named for General "Mad Anthony" Wayne, who had become known for his reckless courage during the Revolutionary War.

The 1800's. Detroit was incorporated as a town in 1802. Fire destroyed the entire settlement in 1805. In rebuilding their community, the people followed a street plan suggested by the layout of Washington, D.C.

British forces captured the city during the War of 1812 and held it briefly. In 1815, Detroit was incorporated as a city. Detroit served as Michigan's first capital from 1837

until 1847, when Lansing became the capital. The opening of the Erie Canal in 1825 provided a cheap water route between the East and Northwest. Thousands of settlers moved to Detroit from New York and New England, and the city became a commercial center.

In 1855, the Soo Canals were completed on the United States-Canadian border, and shipping on the Great Lakes increased. This traffic aided the growth of industry in Detroit, and the city's population climbed to 45,600 by 1860. At that time, Detroit served mainly as a marketing center for the farm products of the area.

During the late 1800's, manufacturing became the city's chief activity. By 1880, Detroit had 116,000 people and more than 900 factories.

The early 1900's. During the early 1900's, a group of inventors helped make the city the center of the U.S. automobile industry. They included Henry Ford, John and Horace Dodge, and Ransom E. Olds. The automobile industry grew rapidly in Detroit, partly because the city had a large labor supply. In addition, land and lake routes made it easy and cheap to bring raw materials to Detroit. From 1900 to 1910, the city's population rose from 285,704 to 465,766.

During World War I (1914-1918), Detroit produced airplane motors, armored vehicles, and trucks for the Allies. Detroit's population soared and reached over 1 $\frac{1}{2}$ million by 1930. The city suffered widespread unemployment during the Great Depression of the 1930's. In 1935, the United Automobile Workers (UAW) labor union was organized in Detroit. A UAW strike in 1937 caused the GM Corporation to recognize the union and greatly strengthened the U.S. labor movement.

The mid-1900's. During World War II (1939-1945), Detroit's automobile plants switched to the manufacture of military products, including aircraft, artillery, and jeeps. The city manufactured huge amounts of military equipment and became known as the Arsenal of Democracy.

The war created thousands of jobs in Detroit. Many people from other parts of the United States, including great numbers of African Americans from the South, came to the city seeking work. Competition between the city's blacks and whites for jobs and housing led to a race riot in 1943. Thirty-four people were killed and more than 1,000 were injured in the outbreak.

By 1950, Detroit's population had reached 1,849,568. The city was ranked as the fifth largest in the United States. The rapid population growth created several problems. Schools became overcrowded, crime increased, and race relations grew more tense.

Detroit began many urban renewal projects during the 1950's and 1960's. Slums were cleared in 17 areas, and the city erected nine large, low-rent housing developments and a medical center. The $106-million Civic Center was built along the waterfront.

A trend toward suburban living developed in the 1950's, and thousands of white middle-class families moved from Detroit to new developments outside of the city. The population fell to 1,670,144 by 1960.

In July 1967, rioting broke out in a chiefly African American section of Detroit. Rioters burned buildings, looted stores, and shot at police officers and firefighters. National Guard and U.S. Army troops helped restore order. The riot lasted a week and resulted in 43 deaths and $250 million in property damage. After this riot, many civic organizations were formed to ease racial tension and help improve education, housing, and job opportunities for blacks. They included New Detroit Inc., the Economic Development Corporation, and Focus:HOPE.

The late 1900's. In 1973, Coleman A. Young was elected the city's first African American mayor. He was reelected four times and remained in office until 1993.

Renaissance Center, one of the largest renewal projects in U.S. history, opened on the downtown riverfront in 1977. The $340-million project included four 39-story office buildings, a circular 73-story hotel, and several shopping malls. In 1996, the complex became the world headquarters for the General Motors Corporation.

From the mid-1980's to the early 1990's, some development took place along the route of Detroit's People Mover system, which began operating in 1987. For example, Cobo Hall doubled its exhibition space. In the early 1990's, after 20 years of bitter debate, Detroiters voted to approve casino gambling.

Detroit's automobile industry experienced periods of decline and periods of recovery during the late 1900's. The declines caused hardships to the city's economy. By 1990, Detroit's population had fallen to 1,027,974.

The early 2000's. According to the 2000 census, Detroit had 951,270 people. The city ranked as the 10th largest in the country. In 2001, Detroit celebrated the 300th anniversary of its founding. Tricentennial festivals and programs were offered throughout the year in the Detroit area. Peter Gavrilovich

Related articles in *World Book* include:
Cadillac, Antoine de Lamothe
Ford, Henry
Ford, Henry, II
General Motors Corporation
Michigan (pictures)
Museum of African American History
Young, Coleman Alexander

Detroit River is one of the most important inland waterways in North America. A strait, it connects Lake St. Clair and Lake Erie. It also forms part of the boundary between the state of Michigan in the United States and the Canadian province of Ontario. The river carries much of the grain shipped from the Canadian Prairie Provinces and the U.S. northern Great Plains. Ships also use the river to carry iron ore from Minnesota and northern Michigan ports and coal, potash, and forest products from Thunder Bay, Ontario.

The Detroit River is about 25 miles (40 kilometers) long and from $\frac{1}{2}$ mile to 3 miles (0.8 to 5 kilometers) wide. Warehouses, factories, office buildings, homes, and parks line its banks. Boating is popular. The river has several island parks, including Michigan's Belle Isle and Ontario's Peche Island Provincial Park and Bois Blanc (also called Bob Lo). Grosse Ile, Michigan, the largest island, is a residential area. The Ambassador Bridge over the river and an automobile tunnel under the river link Detroit, Michigan, and Windsor, Ontario.

Richard A. Santer

Deucalion, *doo KAY lee uhn,* was the "Noah" of Greek mythology. He was the son of Prometheus, who was a member of the earliest race of gods, called Titans. When Zeus decided to destroy all humans by a flood because of their wickedness, Prometheus warned Deucalion and Deucalion's wife, Pyrrha. He told them to build a wooden ark. They floated in it for nine days until they landed on top of Mount Parnassus. When the water went down, they were the only living creatures left on the earth.

Deucalion and Pyrrha asked the oracle at Delphi how they might restore humanity. The oracle told them to "throw the bones of their mother." They guessed this to mean stones, the bones of mother earth. The stones Deucalion threw became men, and those that Pyrrha threw became women. Deucalion and Pyrrha became the ancestors of the Greeks through their son Hellen, for whom the Hellenes (Greeks) were named. The grave of Deucalion was said to be visible in the city of Athens in the ancient temple of Zeus. William F. Hansen

Deuterium, *doo TIHR ee uhm* or *dyoo TIHR ee uhm,* also called *heavy hydrogen,* is a stable isotope of hydrogen (see **Isotope**). Its chemical symbol is D or ^2H. Deuterium is an essential part of the hydrogen bomb, and is used in research in atomic physics, biochemistry, and chemistry. About 1 part in 6,700 parts of all normal hydrogen is deuterium.

Properties. The mass of an atom of deuterium is about twice that of a normal hydrogen atom. The nucleus of an ordinary hydrogen atom contains only a proton. A hydrogen atom has the atomic mass 1.0079. The nucleus of a deuterium atom, called a *deuteron,* contains a proton and a neutron. Deuterium has an atomic mass of 2.01410. Deuterium atoms and ordinary hydrogen atoms have one electron. Chemically, deuterium reacts in the same way as ordinary hydrogen. But it generally reacts more slowly and less completely. Deuterium combines with oxygen to form *deuterium oxide* (D_2O), commonly called *heavy water* (see **Heavy water**). Deuterium oxide is used as a *moderator* in heavy water nuclear reactors to reduce the speed of the neutrons released in a nuclear chain reaction.

Uses. Scientists frequently use deuterium to study organic and biochemical reactions. In a process known as *deuterium labeling,* the heavy hydrogen atom serves as an *isotopic tracer* by acting as a substitute for one or more of the regular hydrogen atoms in a molecule. After the reaction is completed, the deuterium can be located by spectroscopic studies. This technique gives scientists important clues as to how the reaction takes place.

Scientists use deuterons as bombarding particles in particle accelerators. One such device, a *cyclotron,* can accelerate deuterons to energy levels of millions or even billions of electron volts. When these particles hit the target material, they alter the composition of its atoms and form another element or a new isotope of the original element (see **Transmutation of elements**).

Another isotope of hydrogen, called *tritium,* has an atomic mass of about 3. It contains one proton plus two neutrons, and is unstable. When a mixture of deuterium and tritium is triggered by an atomic explosion, a *thermonuclear* (heat-induced) chain reaction takes place. The atoms of the hydrogen isotopes fuse with each other and release energy (see **Fusion; Nuclear weapon** [Thermonuclear weapons]).

Discovery. Harold C. Urey, an American chemist, announced his discovery of deuterium in 1932. Urey applied Niels Bohr's theories of the atom to the hydrogen atom (see **Bohr, Niels**). He distilled liquid hydrogen and detected deuterium in the liquid remaining. Urey won the Nobel Prize in 1934 for his discovery. Gilbert N. Lewis, an American chemist, first separated deuterium oxide from ordinary water in 1932. Peter A. Rock

See also **Hydrogen; Isotope; Tritium; Urey, Harold C.**

Deuteronomy, *doo tuh RAHN uh mee,* is the name of the fifth book of the Bible, and the last book of the Pentateuch, or Five Books of Moses. The book is written as if it were Moses' farewell speech to the Israelites before they entered the Promised Land, though the book does not claim that Moses was the author (see **Moses**). Scholars agree that some parts may date back to the time of Moses but that the book as a whole is probably from the 700's B.C. During the reign of Josiah (639 B.C. to 608 B.C.), a book of law usually identified as an early form of Deuteronomy was found in the Temple in Jerusalem. It became part of a sweeping reform of Israelite life.

Deuteronomy is presented in the style of a sermon. It contains history, laws, a *covenant* (solemn agreement between the people and God), and poetry. It presents these materials in a personal way, calling on the people to obey God.

Deuteronomy can be divided into five main sections. (1) *The introductory speeches* (1: 1-4: 43) review the historical basis of Israel's obligation to accept God's rule. (2) *The laws* (4: 44-26: 19) deal with all areas of life. Many of them, including the Ten Commandments (5: 6-21), repeat or expand laws that appear earlier in the Pentateuch. (3) *The covenant section* (27-30) ends with a vivid description of the blessings for the people if they are loyal to God and the curses if they are not. (4) *Moses' farewell* (31-33) includes two well-known poetic songs about his death, the *Song of Moses* (32) and *the Blessing of Moses* (33). (5) *Moses' death* (34) is a moving account of that event.

In addition to obedience to God, Deuteronomy is concerned with justice and equality for all members of society, especially the weaker ones. The book also emphasizes God's great love for the people. The book's ideas influenced the next six Biblical books, which are sometimes called the *Deuteronomic History.* Deuteronomy is also one of the works most frequently quoted in the New Testament. Carol L. Meyers

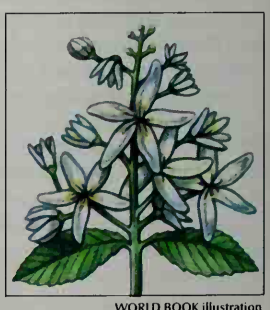
See also **Josiah; Pentateuch; Ten Commandments.**

Deutsche mark. See **Mark.**

Deutschland. See **Germany.**

Deutschland über Alles, *DOYCH lahnt OO bur UHL uhs,* or *Germany Over All,* became Germany's national anthem in 1922. Germany was divided into west and east sections at the end of World War II. In 1952, the third stanza of *Deutschland über Alles* (*Das Deutschlandlied*) became West Germany's anthem. East Germany chose a different song as its anthem. East Germany and West Germany were unified in 1990. United Germany then adopted the third stanza as its anthem. Hoffmann von Fallersleben composed *Deutschland über Alles* in 1841.

Deutzia, *DOOT see uh,* is the name of a group of shrubs native to eastern Asia and Central America. They also grow in many northern regions. Deutzias have clusters of white, pink, or purplish flowers. They bloom in spring or early summer, and usually



WORLD BOOK illustration by Carol A. Brozman

Deutzia

have five petals. The leaves have small teeth along the edges and are covered with a rough fuzz. Deutzias grow to about 6 feet (1.8 meters) high. They grow best in well-drained soil. Fred T. Davies, Jr.

Scientific classification. Deutzias make up a genus in the saxifrage family, Saxifragaceae.

De Vaca. See Cabeza de Vaca, Álvar Núñez.

De Valera, *DEHV uh LAIR uh,* **Eamon,** *AY muhn* (1882-1975), was a leader in Ireland's fight to win independence. De Valera was born in New York City, of a Spanish father and an Irish mother. He spent his childhood in Ireland and became a leader in the unsuccessful Easter Rising in 1916. A British court sentenced him to death, but the sentence was changed to life imprisonment because he was American-born. He was released in 1917. The Sinn Féin convention of 1917 elected him "President of the Irish Republic," a paper organization. He was sent to prison again in 1918. While in prison, de Valera was elected to the British Parliament. But like all Sinn Féin electoral victors, he refused to take his seat. He escaped from prison in 1919 and returned to Dublin, where he was elected president of an Irish parliament. Later in 1919, he left for the United States on an 18-month fund-raising tour for the self-proclaimed Irish Republic.

In 1921, de Valera took part in negotiations with the British government that established the Irish Free State. But this settlement divided Ireland, and he opposed it. In 1926, de Valera quit as president of Sinn Féin because the party refused to recognize the Dáil Éireann (Assembly of Ireland), whose members had to take an oath of allegiance to the British Crown. He then formed the Fianna Fáil (Soldiers of Destiny) party, which won control of the government in 1932.

From 1932 to 1937, de Valera served as president of the Executive Council that governed the Irish Free State. In this position, he held powers similar to those of a prime minister. From 1937 to 1948, he was prime minister of the Irish Free State, which became the Republic of Ireland in 1949. He served as the republic's prime minister from 1951 to 1954 and from 1957 to 1959 and was elected its president in 1959 and 1966. Thomas E. Hachey

See also **Ireland** (The Irish Free State); **Sinn Féin.**

De Valois, *duh VAL wah,* **Ninette,** *nih NEHT* (1898-2001), founded the United Kingdom's Royal Ballet and was its director until her retirement in 1963. She was born Edris Stannus in County Wicklow, Ireland. Ninette De Valois was her stage name. She made her debut as a dancer in 1914. She danced with Sergei Diaghilev's Ballets Russes from 1923 to 1925. From 1926 to 1931, she supervised a dance school in London. In 1931, De Valois moved to the Vic-Wells company, later renamed the Sadler's Wells Ballet. In 1956, the company became the Royal Ballet under a charter given by Queen Elizabeth II.

De Valois *choreographed* (created dances for) several dramatic ballets, including *Job* (1931), *The Rake's Progress* (1935), *Checkmate* (1937), and *Don Quixote* (1950). King George VI made her a Dame Commander in the Order of the British Empire in 1951, and she became known as Dame Ninette De Valois. She wrote an autobiography, *Come Dance With Me* (1957). Dorothy Lourdou

Devaluation is a measure that a government may take to reduce the value of its currency in terms of foreign currencies. It is used under certain conditions when a country has a *pegged* exchange rate—that is, when it specifies the value of its currency in terms of the currencies of other nations. Such conditions include a deficit in the country's balance of payments and insufficient international reserves to support its exchange rate. A balance of payments is a record of a country's business transactions with other countries and includes exports and imports of goods and services. The goal of devaluation is to improve a country's balance of payments by making exported goods cheaper to foreigners and imported goods more expensive to domestic residents.

Robert M. Stern

See also **Balance of payments.**

Developing country is any of the world's poor, or "have-not," nations. Such nations were once called *underdeveloped countries,* but most economists now prefer the terms *developing country, less developed country,* or *L.D.C.* Many of the developing countries are in Africa, Asia, and South America. A typical developing nation has a shortage of food, few sources of power, and a low gross domestic product (GDP). GDP is the value of all the goods and services produced in a country during a year. Economists often classify nations on the basis of *per capita* (for each person) GDP—that is, the GDP divided by the population. Most developing countries have a per capita GDP of less than $3,000. Many have a per capita GDP of only a few hundred dollars. By contrast, many developed nations have a per capita GDP of more than $20,000.

Most developing countries have an increasing population, chiefly because death rates are decreasing and birth rates remain high. These population increases put new pressures on scarce resources. *Physical capital,* such as machinery and efficient transportation systems, is scarce in developing countries. So is *social capital,* such as good education and health systems and stable government. Disease, illiteracy, and inadequate equipment keep agricultural and commercial production low. These factors are most harmful in rural areas, where most of the people live. The people depend on one or two main crops, and suffer if these crops fail. Richer nations are helping some developing countries conquer poverty, but progress is uneven. Some countries, especially in Africa, are becoming poorer. About three-fourths of the world's people still live in developing countries. W. Scott Thompson

Related articles in *World Book* include:
Agriculture (Recent developments)
Colonialism
Economics (Developing economies)
Foreign aid
Industry (How industry varies around the world)
National park (Development of park resources)
Peace Corps
Technical assistance
Third World
United Nations Industrial Development Organization
Women's movements (In developing nations)

Developmental psychology is the study of changes in behavior during a lifetime. Many developmental psychologists study only a part of the life span. Most of these psychologists are chiefly interested in childhood and adolescence, the period between birth and the early 20's.

There are four main theories of child development that psychologists use in research on the behavior of

children: (1) maturational theory, (2) psychoanalytic theory, (3) learning theory, and (4) cognitive theory.

Maturational theory states that the chief principle of developmental change is *maturation,* which means physiological "ripening," especially of the nervous system. Arnold L. Gesell, the leading American supporter of this theory, found that the growing child's behavior seems to follow a set developmental pattern. He believed differences among people result more from heredity than from environment.

Psychoanalytic theory is based on a theory by the Austrian psychiatrist Sigmund Freud. According to Freud, children are driven by impulses of sex and aggression. Children develop through an interaction between their needs, based on sexual impulses, and the demands of their environment. Environmental demands are represented first by loving and restricting parents, and later by the children's own version of their parents' demands. See **Libido; Psychoanalysis.**

Freud's daughter Anna, the American psychologist Erik Erikson, and others have modified Freud's theory and applied it to child behavior. In the psychoanalytic view of development, children change through conflicts, chiefly between their own impulses and the demands of reality. Successful solutions of these conflicts bring normal development, and unsuccessful solutions may lead to mental illness.

Learning theory says a child's development depends mainly on experience with reward and punishment. The child must learn certain responses—such as speech, manners, and attitudes—from adults. Children learn these responses primarily through their association with *reinforcement* (pleasant consequences following certain behavior). If a mother smiles at her child each time the child is polite to adults, her smile reinforces the learning of manners. The task of the adult is to arrange the environment so that it provides suitable and effective reinforcements for desired behavior.

Learning theorists base their ideas on two types of learning—*classical conditioning,* discovered by the Russian physiologist Ivan P. Pavlov; and *instrumental conditioning,* studied by the American psychologists E. L. Thorndike and B. F. Skinner. Maturation and heredity have relatively little importance in the learning theory.

Cognitive theory regards the child as an active solver of problems. Cognitive theorists emphasize the role of a child's natural motivation as a key factor in development. This motivation can include the desire of children to satisfy their curiosity, master challenging tasks, or reduce the inconsistencies and ambiguities they find in the world about them. According to cognitive theory, children form their own theories about the world and the relationships among its different aspects. The theories are primitive at first, but become more realistic after being tested against the child's experience.

There are two dominant types of cognitive theories of development. These types are derived from the theory of Swiss psychologist Jean Piaget and from an analogy to information processing in computers. Piaget described how growing children change their ideas about number, cause, time, space, and morality. First, the children represent the world in terms of their own activities. Then they move to a limited set of generalizations based on their knowledge of specific cases. Finally, they gain the ability to make valid and abstract generalizations about reality. The computer-analogy theories emphasize the development during childhood of more complex *strategies* for organizing information, understanding phenomena, and solving problems. Some psychologists believe the development of such strategies becomes possible with advancing age and experience.

Maturity and old age. Scientists have established that sensory *acuity* (keenness), speed of response, productivity in art and science, and the ability to process new information decline with age, particularly after the late 50's. Less well documented are declines in memory and in the ability to solve familiar kinds of problems. Little is known about the most remarkable fact of old age—that some people decline with the passage of years, and others remain capable and active. S. M. Kosslyn

Related articles in *World Book* include:

Adolescent
Baby
Behavior
Child
Erikson, Erik H.
Freud, Anna
Freud, Sigmund
Learning (How we learn)
Motivation
Old age
Personality
Piaget, Jean
Skinner, B. F.
Thorndike, Edward L.

Devil, according to many religions, is an evil spirit that opposes God or good spirits. The Devil tempts people to be wicked. He is the chief Tempter and may command many lesser devils. In Judaism and Christianity, the Devil is also known as *Satan.* In Islam, the religion of the Muslims, the Devil is known as *Iblis.*

Sometimes the religious belief in devils is combined with folklore about ghosts and demons. Most Oriental religions do not accept a single supreme Devil, such as Satan or Iblis. These religions teach that countless devils of somewhat equal rank try to harm human beings.

In the Old Testament, the Devil is a *satan,* a Hebrew word that means *adversary.* The Devil serves as a kind of accuser or prosecutor in God's heavenly court. In the Book of Job, which dates from about the 600's to the 400's B.C., God permits the Devil to test the faith of Job by overwhelming him with misfortunes. Through the centuries, the Devil has been perceived as an evil angel. By the time of the New Testament, he was seen as the opponent of God and one who had been expelled from heaven. Since then, the Devil has been portrayed as tempting humanity to turn against God. According to medieval thought, the Devil is one who rules hell, where he and his followers punish the damned.

In many works of art and literature, Satan and other devils are portrayed with animal features, particularly bat's wings, split hooves, and a barbed tail. These features probably symbolize the Devil's beastly lust and passion. Many modern theologians consider the Devil to be a symbol of the power of evil, of the worst qualities of human nature, or of the destructive forces in the universe. J. H. Charlesworth

See also **Beelzebub; Devil worship; Exorcism; Lucifer; Mephistopheles; Witchcraft** (History).

Additional resources

Messadie, Gerald. *A History of the Devil.* Kodansha, 1996.

Pagels, Elaine H. *The Origin of Satan.* 1995. Reprint. Random Hse., 1996.

Russell, Jeffrey B. *The Prince of Darkness: Radical Evil and the Power of Good in History.* 1988. Reprint. Cornell Univ. Pr., 1992.

Devil worship is the practice of worshiping demons or other evil spirits. Only a few groups actually worship devils or other beings they consider evil. Members of a Brazilian religious group worship evil spirits called *Exus,* who they believe will harm their enemies. An anti-Christian movement called *Satanism* has a small number of followers in Europe and North America. Satanism involves elements of magic and witchcraft. Its chief ceremony is the *Black Mass,* a distorted version of a Christian church service in which the worshipers praise Satan and ridicule God.

A Middle Eastern religious group called the Yazidis acquired the name *devil worshipers* through a misunderstanding. Like early Christians, the Yazidis believe the Devil was once the chief angel but was expelled from heaven because of his rebellious pride. According to the Yazidis, however, the Devil repented and was restored to his former position by God. The Yazidis worship the Devil as the chief angel, who rules the world on behalf of God. Robert S. Ellwood, Jr.

Devils Island. See French Guiana.

Devil's paintbrush, also called *orange hawkweed,* is a flowering plant native to Europe. It grows as a weed in much of North America. The plant bears orange-red flowers on a leafless stem that may reach 28 inches (71 centimeters) high. Oblong leaves grow at the stem's base. The paintbrush appearance comes from a row of bristles on the seeds. David J. Keil

Scientific classification. Devil's paintbrush belongs to the family Asteraceae or Compositae. It is *Hieracium aurantiacum.*

WORLD BOOK illustration by Christabel King

Devil's paintbrush

Devils Postpile National Monument is in the Inyo National Forest in east-central California. The monument contains a spectacular volcanic mass of blue-gray basalt columns that resemble a pile of posts. They tower 60 feet (18 meters) above the San Joaquin River. The monument was established in 1911. For its area, see **National Park System** (table: National monuments).

Critically reviewed by the National Park Service

Devils Tower National Monument is in northeastern Wyoming. It contains a tower of volcanic rock that rises 865 feet (264 meters) from the hills bordering the Belle Fourche River. The monument, established in 1906, was the first national monument in the United States. For its area, see **National Park System** (table: National monuments). See also **Wyoming** (picture: Devils Tower).

Critically reviewed by the National Park Service

Devil's Triangle. See **Bermuda Triangle.**

Devolution, *DEHV uh LOO shuhn,* occurs when a country's central government grants some of its powers to regional governments. In some cases, devolution creates new regional governing bodies. Such responsibilities as defense and foreign policy remain with the central government. Responsibilities administered on a local level, such as education or transportation, *devolve* (transfer) to the regional governments.

For example, in the late 1990's, the government of the United Kingdom devolved some of its powers to the governments of Northern Ireland, Scotland, and Wales. In each region, a new assembly of elected representatives was created to handle the new responsibilities.

Devolution is different from *federalism.* Under federalism, the powers of central and of regional government are defined by laws that neither side can easily change. Under devolution, the central government controls the arrangement. It can extend, alter, or take back the responsibilities it has given to the regions. In practice, however, the central government may find that it cannot take back the powers it has given out. Once regions have governed themselves, they may be reluctant to give up self-rule. Rodney Barker

See also **Federalism; Home rule; Scotland** (Devolution); **United Kingdom** (Governmental changes).

Devonian Period, *duh VOH nee uhn,* in geology, is a period of the earth's history. It began approximately 410 million years ago and lasted for 50 million years. During this time, seas covered large areas of the continents, laying down thick sediment that became rock. The Devonian Period has been called the Age of Fishes.

See also **Earth** (table: Outline of Earth's history); **Fish** (The Age of Fishes); **Prehistoric animal** (The first animals with backbones).

Devonshire, Duke of (1868-1938), was governor general of Canada from 1916 to 1921. He served during World War I (1914-1918), when French-Canadian opposition to Canada's military draft divided the nation. Devonshire worked to reestablish national unity.

Devonshire was born on May 31, 1868, in London. His given name was Victor Christian William Cavendish. He was elected to the British Parliament in 1891. He was treasurer to the household of Queen Victoria in 1900, and of King Edward VII from 1901 to 1903. Cavendish became Duke of Devonshire on the death of his uncle in 1908. From 1922 to 1924, he served as secretary of state for the United Kingdom's colonies. Jacques Monet

De Voto, Bernard Augustine (1897-1955), an American novelist, journalist, and conservationist, promoted the American West in his works. He celebrated the West's scenery, lore, and culture in "The Easy Chair," a column he wrote for *Harper's* magazine from 1935 to 1955. De Voto also wrote such important social histories as *Mark Twain's America* (1932); *The Year of Decision: 1846* (1943); and *Across the Wide Missouri* (1947), for which he won the 1948 Pulitzer Prize in history. De Voto financed his more serious works by writing novels under the pen name John August. He served as editor of *The Saturday Review of Literature* from 1936 to 1938. De Voto was born on Jan. 11, 1897, in Ogden, Utah.

Lee B. Jolliffe

De Vries, *duh VREES,* Hugo (1848-1935), a Dutch botanist and student of organic evolution, was known primarily as the author of the *mutation theory.* This theory states that new species of plants and animals arise by *mutations* (sudden transformations) which might appear at any time and are then continued from generation to generation. De Vries's work stimulated research on heredity and evolution. However, mutations as conspic-

uous as those he described in the evening primrose were later proved to be the exception, not the rule. Born in Haarlem, the Netherlands, de Vries became famous with the publication of *The Mutation Theory* (1901-1903). See also **Mutation.** Keith R. Benson

Dew is the name given to the glistening beads of water that often appear on blades of grass, leaves, and car tops early on clear mornings. Dew forms when air near the ground cools to the point where it cannot hold all its water vapor. The excess water vapor then *condenses* (changes to liquid) on objects near the ground.

During the day, objects absorb heat from the sun. At night, they lose this heat through a process called *thermal radiation.* As objects near the ground cool, the air immediately surrounding them also cools. Colder air cannot hold as much water vapor as warmer air can. If the air continues to cool, it will eventually reach the *dew point.* The dew point is the temperature at which the air contains as much water vapor as it possibly can hold (see **Dew point**). If the air cools further, some of the vapor condenses on the nearest available surface.

Dew forms best on calm, clear nights. When the wind is blowing, air cannot stay in contact with cool objects as long and it needs more time to cool to the dew point. When it is cloudy, objects cool more slowly because the clouds radiate heat back to Earth. Dew also forms better when the humidity is high. Dew evaporates as the sun rises. Sunshine heats the ground, which in turn warms the air. This air is able to hold more water vapor, and dew evaporates into the air. When ordinary dew forms at the dew point and then freezes, it is called *frozen dew* or *white dew. Frost* forms when the dew point is below freezing, causing excess water vapor to freeze directly onto objects near the ground. Alexis B. Long

See also **Air** (Moisture in the air); **Frost; Humidity.**

DEW line. See **North Warning System.**

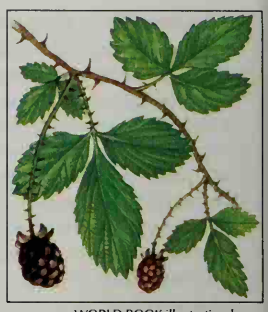
Dew point is the temperature at which moisture in the air begins to condense. The dew point is either lower than the air temperature, or the same as the air temperature, when the relative humidity is 100 percent. Dew forms when a thin film of air, in contact with the surface, is cooled to below the dew point. This cooling of the air causes dew on the surface or fog in the air, when the dew point is above the freezing temperature. If the air temperature and dew point are below freezing, frost may form on the surface, or ice crystals may form in the air. Fog and clouds occur when large volumes of air are cooled to below the dew point. Margaret A. LeMone

See also **Dew; Fog; Frost; Humidity.**

Dewberry is a small, oval fruit that grows on a trailing blackberry plant. Unlike other blackberries, which grow on erect bushes, dewberries develop on long, slender branches that spread along the ground. They are black or shades of red. Each fruit consists of a cluster of tiny fruits called *drupelets.* Dewberries are eaten fresh or used to make pies, jelly, jam, or wine.

Dewberries grow wild across much of North America. They are also grown commercially in some states, including Arkansas, California, Oregon, and Washington. British Columbia is the main dewberry-producing province in Canada. Commercially grown varieties of dewberries include boysenberries and loganberries.

Growers produce dewberry plants by burying sections of stems or roots in mounds of earth. As the plants grow, they are tied to stakes or wire frames to ensure their proper development and to allow growers to care for them easily. The dewberry plants produce new stems each year, but only two-year-old stems bear fruit. After the dewberries are harvested, growers remove the two-year-old stems to make room for new stems to develop. George Pinyuh



WORLD BOOK illustration by Stuart Lafford, Linden Artists Ltd.

Dewberries

Scientific classification. Dewberries belong to the rose family, Rosaceae. The scientific name for the southern dewberry is *Rubus trivialis.* The western dewberry is *R. ursinus.*

See also **Blackberry; Boysenberry; Loganberry.**

Dewey, George (1837-1917), an American naval officer, won fame as the *hero of Manila.* He was the only American ever to become Admiral of the Navy.

Dewey was in Hong Kong in command of the Asiatic Squadron when war broke out between Spain and the United States in 1898. He received orders on April 25 to go to the Philippine Islands and capture or destroy the Spanish fleet. Late on April 30, Dewey's six ships, led by the U.S.S. *Olympia,* approached Manila Bay. Early the next day Dewey gave the captain of the *Olympia* the famous command, "You may fire when you are ready, Gridley," and attacked the Spanish fleet of 10 cruisers and gunboats. By noon, Dewey's force had destroyed the Spanish fleet without the loss of a single American life. This victory made the United States an important power in the Pacific Ocean, and inspired the confidence of the American people in the U.S. Navy. After his victory, Dewey remained in Manila Bay until troops arrived to capture Manila. When Dewey returned to New York City in 1899, he received a great welcome. People donated funds to buy a home for him in Washington, D.C.

Dewey was born on Dec. 26, 1837, in Montpelier, Vermont. He studied at the U.S. Naval Academy in Annapolis. He first fought in the Navy during the Civil War (1861-1865). As a lieutenant, Dewey became the executive officer of the U.S.S. *Mississippi* in David Farragut's fleet in 1861. He took part in the famous run past the forts that guarded New Orleans. Later, he served on Farragut's flagship (see **Farragut, David G.**).

Dewey became president of the newly created General Board of the Navy Department in 1900. He served as an honored adviser on all naval matters until his death. Donald W. Mitchell

See also **Spanish-American War.**

Dewey, John (1859-1952), was an American philosopher and educator. He helped lead a philosophical movement called Pragmatism (see **Pragmatism**).

Dewey was strongly influenced by the then-new science of psychology and by the theory of evolution proposed by the English scientist Charles R. Darwin. Dewey came to regard intelligence as a power that people use when they face a conflict or challenge. He believed that people live by custom and habit. In most situations, it is sufficient to think and act as we have done in the past, but some physical and social situations present prob-

lems calling for new responses. According to Dewey, we cannot solve such problems by habitual action and thought. We must use intelligence as an instrument for overcoming any obstacles. Dewey's philosophy is thus called Instrumentalism.

Dewey believed that knowledge is a means of controlling the environment, ideally to improve the quality of human life. He wrote widely on art, democracy, education, philosophy, and science. In his writings, Dewey always focused on the same problem—how to close the gap between thought and action. Dewey's interpretation of science shows how thought and action are united. He considered science as a way to inquire into the behavior of things. The results of such inquiry are the joint products of thought and activity. Dewey regarded *activity* as conducting experiments under controlled situations and *thought* as those theories that guide our experiments.

In every area of life, Dewey called for experimenting. As an educator, he opposed the traditional method of learning by memory under the authority of teachers. He believed that education should not be concerned only with the mind. Students should develop manual skills. Learning must be related to the interests of students and connected with current problems. Dewey declared that education must include a student's physical and moral well-being as well as intellectual development.

In *Art as Experience* (1934), Dewey linked works of art with the experiences of everyday life. He wrote that daily experience can be glorious, joyous, sad, tedious, terrifying, and tragic. These, he said, are the qualities that architects, composers, painters, and writers seek to capture and express in their works. Dewey regarded education as incomplete if it ignores these experiences.

Dewey was born on Oct. 20, 1859, in Burlington, Vermont. He had a distinguished teaching career, especially at Columbia University. Dewey's works include *Democracy and Education* (1916), *Reconstruction in Philosophy* (1920), and *Experience and Nature* (1925). John E. Smith

See also **Progressive education** (with picture).

Additional resources

Campbell, James. *Understanding John Dewey.* Open Court, 1995.
Westbrook, Robert B. *John Dewey and American Democracy.* 1991. Reprint. Cornell Univ. Pr., 1993.

Dewey, Melvil (1851-1931), an American librarian, began the decimal library-classification system (see **Dewey Decimal Classification**). Dewey founded the American Library Association and the *Library Journal* in 1876 (see **American Library Association**). He became chief librarian of Columbia University in 1883 and set up the first library school there in 1887. He directed the New York State Library from 1889 to 1906. He was born on Dec. 10, 1851, in Adams Center, New York. James G. Williams

Dewey, Thomas Edmund (1902-1971), a prosecuting attorney and Republican politician, served as governor of New York from 1943 to 1954. He ran unsuccessfully for president of the United States on the Republican ticket in 1944 and 1948. Dewey's running mates for vice president were John Bricker and Earl Warren.

Dewey was born on March 24, 1902, in Owosso, Michigan. He graduated from the University of Michigan and finished his law course at Columbia University in two years. In 1933, he became U.S. attorney for the southern district of New York state. Governor Herbert Lehman appointed him special prosecutor for vice and racket investigations in New York City in 1935. Dewey's vigorous and successful prosecution of organized crime brought him wide recognition.

Dewey was defeated for the New York governorship in 1938 but was elected in 1942, the first Republican governor of the state in 20 years. He was reelected in 1946 and 1950 but did not seek reelection in 1954. Dewey's loss to President Harry S. Truman in the 1948 presidential race was considered a major upset. Dewey returned to his private law practice in 1955. Richard L. Watson, Jr.

See also **Truman, Harry S.** (Election of 1948).

Dewey Decimal Classification is the most widely used method of classifying books in a library. It is named for Melvil Dewey, who developed it in 1876 (see **Dewey, Melvil**). This system classifies books by dividing them into 10 main groups, each represented by figures, as in the table with this article.

Each of these 10 main classes is broken up into more specialized fields. For example, class 600-699, Technology, is subdivided into 10 special classes. Each of these divisions is further subdivided. The numbers 630-639, for example, represent Agriculture and are subdivided into such classes as Field Crops, Garden Crops, and Dairy and Related Technologies. When the classification becomes extremely fine, decimals are used to represent specific areas. For example, books on useful insects, such as bees and silkworms, are grouped under the number 638. Books on beekeeping are in 638.1, and those on silkworms in 638.2.

Main Dewey Decimal Classification groups

000-099	Generalities (encyclopedias, bibliographies, periodicals, journalism)
100-199	Philosophy and related disciplines (philosophy, psychology, logic)
200-299	Religion
300-399	Social sciences (economics, sociology, civics, law, education, vocations, customs)
400-499	Language (language, dictionaries, grammar)
500-599	Pure sciences (mathematics, astronomy, physics, chemistry, geology, paleontology, biology, zoology, botany)
600-699	Technology and applied sciences (medicine, engineering, agriculture, home economics, business, radio, television, aviation)
700-799	The arts (architecture, sculpture, painting, music, photography, recreation)
800-899	Literature (novels, poetry, plays, criticism)
900-999	Geography, history, and related disciplines

Not all libraries use the Dewey Decimal Classification. Many follow another system developed by the Library of Congress (see **Library of Congress Classification**).

Deanne B. Holzberlein

Additional resources

Chan, Lois M., and others. *Dewey Decimal Classification.* Rev. ed. Forest Pr., 1996.
Fowler, Allan. *The Dewey Decimal System.* Children's Pr., 1996.

Dextrin, *DEHKS trihn,* is a sticky substance formed during the chemical breakdown of starch. Some dextrins are used as a *mucilage* (glue) on postage stamps and envelopes. Dextrins are also used in *sizing* (stiffen-

ing) paper and textiles. Such commercial dextrins are produced by treating starch with heat or acid or both. Dextrins are also produced in the human body. During digestion, starch-containing foods are broken down into dextrins and other products. Starch is also converted into dextrins during the baking of foods. See also **Starch.** James Nelson Rieck

Dextrose, *DEHKS trohs,* is the name used in industry for pure, crystalline glucose sugar. It is usually sold in the form of fine, white *granules* (grains). Dextrose is produced commercially by treatment of starch with the enzyme *amylase* or by putting starch in water mixed with dilute hydrochloric acid. When the starch-acid mixture is heated under steam pressure in a converter, it changes to glucose. Glucose can be purified and dried to fine granules called dextrose. As a pure white sugar, dextrose is used mainly in candy, baked goods, and canned fruit. As a syrup, dextrose is used in *high-fructose corn syrup,* a sweetener in foods and beverages. Dextrose is not as sweet as *sucrose* (common table sugar). See also **Glucose.** Kay Franzen Jamieson

Dhaka, *DAK uh* (pop. 3,637,892), is the capital, largest city, and commercial and industrial center of Bangladesh. Dhaka, formerly spelled *Dacca,* lies on the Buriganga River. For location, see **Bangladesh** (map).

Dhaka's old section, called the Sadarghat, includes the city's main shopping district and a busy outdoor market known as the Chauk. This area has many *mosques* (Muslim houses of worship). Some of them are hundreds of years old. Many poor families live in crowded slums in the Sadarghat. Middle-class and wealthy people make up a majority of the population of Ramna, one of the city's fastest growing areas. Ramna lies in northern Dhaka. It is the home of the University of Dhaka. Ramna has many treelined streets, a park, and a shopping district.

The central location of Dhaka helped it become the nation's commercial and industrial center. Factories operate in many parts of the city and its suburbs. The Dhaka area's major products include cotton fabrics, glass, leather, metals, sugar, and *jute,* a plant fiber used in making rope and certain fabrics.

Settlers from south Asia founded Dhaka in the A.D. 600's. In 1608, the city became the capital of Bengal, a province of the Mughal Empire (see **Mughal Empire**). Dhaka came under British control during the mid-1700's as part of India. India gained independence from the United Kingdom in 1947, and part of it—including what is now Bangladesh—became the independent nation of Pakistan. Dhaka was the capital of the Pakistani province of East Pakistan. In 1971, civil war in Pakistan led to the establishment of East Pakistan as an independent nation, Bangladesh, with Dhaka as the capital. P. P. Karan

See also **Bangladesh** (pictures).

Dharma, *DAHR muh,* is the moral and religious law of Buddhism and Hinduism. Each of these religions has its own dharma.

In Buddhism, the dharma is reflected in the teachings of Buddha, who founded the religion. The principles of the Buddhist dharma govern daily life and show the way to salvation. Buddha preached that life is a continuing cycle of death and rebirth. He taught that by following Buddhist ways of life called the *Middle Way* and the *Noble Eightfold Path,* a person could overcome suffering and achieve *nirvana,* a state of peace and happiness. Buddha's followers compiled his teachings in a scripture called the *Tripitaka.*

In Hinduism, the dharma establishes rules of duty and ethical conduct for all people. The Hindu dharma also sets forth the responsibilities of the four major *castes* (classes) that make up Hindu society. Writings called the *Dharma Sutras* and the *Dharma Commentaries* explain these principles. Frank E. Reynolds

See also **Buddha; Buddhism; Hinduism; Nirvana.**

Dhole, *dohl,* is a wild dog of Asia. It grows up to 20 inches (51 centimeters) tall at the shoulder and weighs up to 44 pounds (20 kilograms). An adult commonly has rusty-red fur with a paler belly and a black-tipped tail.

Dholes usually live in packs of 5 to 12 family members. But several packs may gather into groups of over 20 animals. Packs hunt during daylight or on moonlit nights. Hunting in packs enables dholes to prey on large animals, including antelope, deer, mountain sheep, and wild pigs. Dholes also eat rodents, lizards, insects, and berries. The dogs communicate through a wide variety of noises. They can bark, growl, scream, and whine. Dholes even use high-pitched whistles that may help keep the pack together during a chase.

Female dholes usually give birth to a litter of 4 to 6 pups after a pregnancy of 60 to 62 days. Mothers keep their pups in dens along stream banks or among boulders. Other members of the pack bring back food for both the mother and her young.

Dholes once were common throughout much of Asia. However, human beings have hunted and poisoned them and destroyed much of their habitat. In many parts of Asia, dholes now live mostly in such protected areas as nature preserves. Duane A. Schlitter

Scientific classification. The dhole belongs to the family Canidae. Its scientific name is *Cuon alpinus.*

Día de los muertos, *DEE ah deh lohs MWEHR tohs,* is a Mexican holiday that honors the dead. The holiday is also celebrated in many Mexican American communities. *Día de los muertos* is Spanish for *day of the dead.* During this celebration, families gather in churches, at cemeteries, and in homes to pray for and remember their deceased loved ones.

Día de los muertos is usually celebrated on November 2, the Roman Catholic feast of All Souls' Day. Some communities remember the dead over several days, including November 1, All Saints' Day. The celebration combines ancient native beliefs and Catholic traditions.

Many families prepare an elaborate altar, known as an *ofrenda* (offering), in their homes and in cemeteries for the holiday. The ofrendas are decorated with flowers, fruits, popular foods, sweets, and drinks. They are created to welcome back for a day the souls of departed family members and friends. Special candies and *pan de muerto* (bread of the dead), a sweet bread, are popular treats served in the shape of skulls, skeletons, and other symbols of death.

The day of the dead reinforces the ancient belief that death is a part of life. It is an important tradition through which families pass on their oral histories. Recalling stories of past family members helps keep these ancestors alive for future generations. Cesáreo Moreno

Diabetes is a long-term disease that disrupts the body's ability to use a sugar called *glucose.* It also hampers use of other nutrients, such as protein and fat. The

formal medical term for the disease is *diabetes mellitus*, pronounced *DY uh BEE tihs*, or *DY uh BEE teez, MEHL uh tuhs*. Glucose is a common product of digestion. It circulates in the blood to the body's cells, where it serves as one of the chief sources of energy. Diabetes disrupts the body's mechanisms for moving glucose out of the bloodstream and using it in cells. As a result, levels of blood glucose—also called *blood sugar*—stay excessively high, leading to serious complications over time.

High blood glucose levels directly affect the eyes, kidneys, and nervous system. In addition, diabetes increases risk of *atherosclerosis*. This condition narrows arteries, especially those that carry blood to the heart, brain, and legs. Diabetes affects more than 100 million people worldwide. It is among the most common causes of death and disability in North America and Europe.

Causes. Diabetes has many causes. Two of the most common forms are called Type 1 and Type 2. These two forms are characterized by the different ways that they disrupt use of glucose and the different ages when they tend to first appear. *Genes* (chemical units of heredity) are important factors in both Type 1 and Type 2 disease.

Type 1 diabetes, also called *insulin-dependent diabetes*, usually results from progressive destruction of insulin-producing cells in the *pancreas*, an organ in the abdomen. Insulin is a hormone that helps bring glucose from the bloodstream into cells, chiefly the cells making up the muscles, body fat, and the liver. Insulin also plays an important role in storing glucose for future energy needs. Low insulin levels impair cells' ability to take up glucose and increase production of glucose from the liver. Both of these processes raise blood sugar.

Experts consider Type 1 diabetes an *autoimmune* disease, because the insulin-producing cells are destroyed by the body's own immune system. The disorder usually develops during childhood or adolescence.

Type 2 diabetes, also called *non-insulin dependent diabetes*, usually appears in people more than 45 years old. In most Type 2 cases, people develop a condition called *insulin resistance*, in which the body's cells resist insulin's effects, and the body does not make enough insulin to overcome the resistance. Insulin resistance may result from a number of factors, including obesity and lack of physical activity.

Symptoms. In most cases, Type 1 diabetes destroys the insulin-producing cells in the pancreas over months or years often without causing noticeable symptoms. Patients may experience a sudden rise in blood sugar levels called *hyperglycemia* when the body can no longer produce enough insulin. When blood sugar rises, high levels of sugar also appear in the urine. In turn, sugar in the urine causes excessive loss of water through the kidneys, leading to frequent urination and extreme thirst. Weight loss also occurs if inability to absorb sugar deprives the body of enough calories.

When cells cannot use glucose, they begin to break down stored fat for energy. Breakdown of fat produces chemicals called *ketones*. In Type 1 diabetes, inability to further process excess ketones may lead to a condition called *ketoacidosis (KEE toh A suh DOH suhs)*. Severe ketoacidosis can lead to nausea, vomiting, and loss of consciousness, and may be fatal if not treated properly.

In most cases of Type 2 diabetes, blood sugar levels rise gradually and ketoacidosis generally does not occur. Many patients have only mild symptoms or no symptoms at all. Many experts recommend adults over 45 years of age have their blood sugar levels tested regularly.

Complications of diabetes depend on how long people have the disease and how well treatment controls their blood glucose levels. Doctors do not know the exact means by which diabetes damages the body. The leading theory is that long-term exposure to excess blood sugar has harmful effects on particular tissues.

In developed countries, diabetes is one of the most common causes of blindness, kidney failure, and amputations. Blindness can result from damage to delicate arteries in the *retina*, the light-sensitive tissue inside the eye. Kidney failure arises from similar damage to tiny clusters of blood vessels in the kidney's blood-filtering units. In toes and feet, damaged nerves and impaired circulation may lead to amputation. Nerves that control heart rate, digestion, urination, and sexual function are also commonly affected. In addition, diabetes patients run a much higher than average risk of developing atherosclerosis in arteries that supply the heart and brain.

Some of these complications, such as eye and kidney disease, are more common in Type 1 disease. Many Type 2 patients also have obesity and high blood pressure, which further increase risk of heart disease.

Treatment. Type 1 diabetes is fatal unless treatment replaces the body's missing insulin. Doctors originally obtained replacement insulin from animals. Today, genetically engineered bacteria produce insulin for medical use. Patients must inject the hormone under their skin, because insulin is broken down by digestion if it is taken by mouth. Different insulin preparations vary in the speed with which they act in the body.

The most effective insulin replacement programs—called *intensive treatment*—maintain blood glucose at nearly normal levels. Such programs involve a diet designed to meet a patient's individual needs and an exercise program. Patients also check their own blood glucose levels frequently. They give themselves three or more insulin injections a day, using an amount of insulin based on their latest blood glucose level. Some patients receive their insulin from a small pump outside their bodies. Intensive treatment enables patients to reduce their risk of developing most of the severe complications by more than 50 percent. But these programs carry a risk of *hypoglycemia* (abnormally low blood sugar).

Some treatments for Type 2 diabetes aim at reducing the body's resistance to insulin. Strategies include losing weight and exercising regularly. Some patients may use insulin or take medications that stimulate their own insulin-producing cells to make more. Other medications reduce insulin resistance, lower glucose production by the liver, or reduce the amount of glucose absorbed during digestion. Many patients achieve the best control of their blood glucose with a combination of treatments.

Research. One active area of investigation focuses on improving methods for monitoring blood glucose and adjusting insulin levels. Another effort involves creating special techniques for transplanting insulin-producing cells. In 2000, Canadian researchers announced that they had developed a technique to successfully transplant insulin-producing cells into patients with Type 1 diabetes. The technique, which is being studied, involves a simple

injection and does not require surgery. The cells are injected into the liver where, even though they are in a different organ, take root and produce sufficient insulin to control blood sugar levels and eliminate daily injections. For Type 2 diabetes, an important goal is finding ways to reduce the extremely high risk of heart disease. Long-term research focuses on better understanding the causes of diabetes so that scientists can develop new approaches to treatment and prevention.

Diabetes insipidus is an extremely rare disease that is unrelated to Type 1 or Type 2 diabetes except by name. The shared name reflects the shared symptom of excessive urination—the word *diabetes* comes from the Greek word for *siphon,* which means *to draw off liquid.* In most cases of diabetes insipidus, the brain produces inadequate amounts of a hormone called *antidiuretic hormone* (ADH). ADH regulates the amount of water lost in urine. Insufficient levels cause excessive urination and may lead to dehydration. Treatment with ADH reduces the large volumes of urine. David M. Nathan

See also **Hodgkin, Dorothy Crowfoot; Hypoglycemia; Insulin.**

Additional resources

American Diabetes Association Complete Guide to Diabetes. Am. Diabetes Assn., 1996.
Ferber, Elizabeth. *Diabetes.* Millbrook, 1996.
Nathan, David. *Diabetes: The Complete Guide.* Times Bks., 1997.
Semple, Carol M. *Diabetes.* Crestwood Hse., 1995. Younger readers.

Diacritical mark, *dy uh KRIHT uh kuhl,* is a sign used with letters of the alphabet to show pronunciation or meaning of words. Diacritical marks are a regular part of spelling in many foreign languages (see the Key to Pronunciation at front of the A volume). In English, some words borrowed from other languages also use diacritical marks, but the marks are mainly used in dictionaries to show how words are pronounced. Diacritical marks in English include the *circumflex* (which is written ˆ as in ôrder); the *dieresis* (¨ as in fär, rüle); the *macron* (¯ as in āge, ēqual, īce, ōpen, ūse); the *tilde* (˜ as in cãre); the *single dot* (˙ as in tėrm, půt); and the *breve* (˘ as in bĕd, pĭt). Marianne Cooley

Diaghilev, *DYAH gih lehf,* **Sergei Pavlovich,** *sehr GAY pah VLAW vihch* (1872-1929), was one of the greatest producers and directors in ballet history. He established ballet as a modern theatrical art. Diaghilev changed Europe's ballet scene and created an audience for dance comparable to that for symphonic music.

Diaghilev was born on March 31, 1872, in the province of Novgorod in Russia. From 1899 to 1901, he was artistic adviser for the Maryinsky Theater in St. Petersburg, Russia. From 1909 to 1929, he directed and produced performances by his own company, the Ballets Russes. At first, he used dancers and *choreographers* (dance composers) from the Russian imperial theaters. Later, he drew from artistic communities elsewhere in Europe, persuading the most innovative artists of the period to collaborate on his ballets. These included dancers Tamara Karsavina, Vaslav Nijinsky, and Anna Pavlova and composers Claude Debussy, Sergei Prokofiev, Maurice Ravel, Erik Satie, and Igor Stravinsky. They also included choreographers George Balanchine, Michel Fokine, and Léonide Massine and artists Léon Bakst and Pablo Picasso.

Diaghilev directed about 80 ballets and operas. Among his company's best-known ballets are *Les Sylphides* (1909), *The Firebird* (1910), *Petrouchka* (1911), *Afternoon of a Faun* (1912), *The Rite of Spring* (1913), *Parade* (1917), and *Apollo* (1928). Dorothy Lourdou

See also **Ballet** (Ballet in Russia); **Ballets Russes; Stravinsky, Igor.**

Diagraming, in grammar. See **Sentence.**

Dialect is a variation of a language used by a particular group of speakers. All spoken languages change through time. Variations in speech may arise from geographic factors, such as the Atlantic Ocean, which separates the United Kingdom and the United States. This separation leads to American and British dialects of the English language. Social factors—such as level of education, economic status, or ethnic background—can also produce separate dialects.

Dialects involve differences in pronunciation, vocabulary, and word patterns. Certain dialects of American English demonstrate such differences. For example, some people who speak the Eastern New England dialect pronounce the word *idea* as *idear.* They may also call the tree commonly known as a *sycamore* a *buttonwood tree.* Speakers of the Western Pennsylvania dialect may call a *chipmunk* a *grinnie.*

Some African Americans speak a variation of English known as *black English, Ebonics,* or *African American vernacular English.* One characteristic of black English is extensive use of the verb *be.* A speaker might say, for example, *She be tall* instead of *She is tall.* Omission of a verb, as in *He a good boy,* is also common. Some language experts think that black English is a dialect whose patterns evolved from West African languages.

The term *dialect* often suggests that there is a standard form of a language that speakers of a dialect do not follow. For example, the French spoken in Paris is considered the standard form of that language. People who do not speak Parisian French are said to speak a dialect. But as a variation of the language, Parisian French must also be considered a dialect. John Baugh

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Grammar (Grammar and usage)
Language (Unusual languages)
Pronunciation (English dialects in the United States)
Slang
Speech

Diameter, in geometry, is the length of any straight line segment that passes through the center of a circle or a sphere and touches the figure's boundaries at opposite points. *Diameter* is also the name of such a line segment.

The diameter of a circle or sphere is twice as long as the figure's *radius.* The radius is the length of any line segment that runs from the center of a circle or a sphere to any point on the figure's boundary. *Radius* is also the name of such a line segment.

The degree of magnification achieved by a microscope or telescope is expressed in *diameters.* For example, a microscope that doubles the apparent size of an object is said to magnify the object two diameters.
Philip S. Marcus

See also **Circle; Microscope; Sphere.**

Diamond is the hardest naturally occurring substance, and also one of the most valuable natural substances. Because of its hardness, the diamond is the most lasting

John Reader

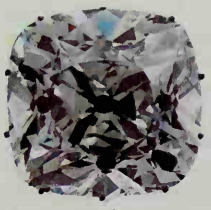
Diamonds have been prized throughout history for their beauty and for their extreme hardness. Skilled cutters and polishers can transform rough diamonds, such as those shown above, into brilliant jewels. Some of the world's most famous diamonds are pictured at the right. Each of these diamonds is shown at about three-fourths its actual size.

of all gemstones. In Europe, America, and Japan, the diamond is widely used for engagement and wedding rings. Diamonds are also used in industry for cutting, grinding, and boring other hard materials. About half of the world's natural diamonds are suitable only for industrial use. A small percentage are set in jewelry.

What diamonds are. Diamonds are crystals that are made up almost entirely of carbon. Some diamond crystals have six faces, but most form *octahedrons,* which have eight faces (see **Octahedron**). Other crystal shapes also occur, some of which are very complex. Natural diamonds probably form in the earth's *upper mantle*—the zone beneath the crust—where high temperature and pressure cause the diamonds to crystallize. The diamonds are later brought to the earth's surface by volcanic activity.

A diamond can only be cut by another diamond. However, a diamond can be cleanly broken with a sharp, accurate blow because of its *cleavage.* Cleavage is a property some minerals have of splitting in certain directions and producing flat, even surfaces. A diamond will not dissolve in acid. But it can be destroyed when it is subjected to intense heat. If a diamond is heated in the presence of oxygen it will burn and form carbon dioxide. If it is heated without oxygen, a diamond will turn to graphite, a form of carbon so soft that it is used as a lubricant.

Where natural diamonds are found. The first diamonds were discovered thousands of years ago in the sand and gravel deposits of stream beds. Diamonds found in such deposits are called *alluvial diamonds.* The diamond fields of South Africa were discovered in 1867, when a farmer's child found "a pretty pebble" near the banks of the Orange River. The "pebble" proved to be a diamond worth $2,500. In 1870, diamonds were discovered for the first time in *kimberlite.* This rare rock forms



The Louvre, Paris

Regent
The Louvre, Paris
140.50 carats
Found in India

Tiffany & Company

Tiffany
Tiffany & Company, New York City
128.51 carats
Found in South Africa

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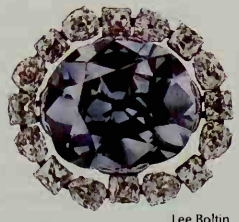
Cullinan I, or Star of Africa
British Crown Jewels, London
530.20 carats
Found in South Africa

Orloff
Diamond Treasury, Moscow
189.60 carats
Found in India

Arnaud de Rosnay from Peter Schub

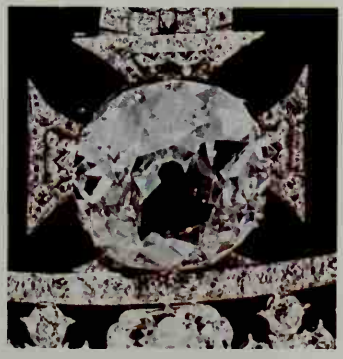


Lee Boltin

Hope
Smithsonian Institution, Washington, D.C.
45.52 carats
Found in India

Baumgold Brothers

Earth Star
Baumgold Brothers, New York City
111.59 carats
Found in South Africa



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Giraudon

Condé
Condé Museum, Chantilly, France
50 carats
Found in India

Koh-i-noor
British Crown Jewels, London
108.93 carats
Found in India

pipe-shaped bodies, which once filled the throats of some volcanoes. A huge diamond deposit was found in 1979 in Western Australia. The Australian diamonds occur in a kind of rock called *lamproite*.

Even in the richest deposits, tons of rock must be mined and crushed to produce one small diamond. Some diamond mines produce about 1 carat (200 milligrams, or .007 ounce) of diamonds for every 3 tons (2.7 metric tons) of rock mined. The world's diamond mines produce over 100 million carats each year. Australia outranks all other countries in production of natural diamonds, accounting for about one-third of world production. Other leading producers include Botswana, Congo (Kinshasa), and Russia.

The United States has no commercial diamond mines. However, kimberlite has been found in Arkansas, Colorado, Michigan, and Montana, and single alluvial diamonds have been discovered in a number of states.

How diamonds are cut to make jewels. Diamonds have great power to reflect light, bend rays of light, and break light up into the colors of the rainbow. But to produce the greatest possible brilliance in a diamond, many little *facets* (sides) must be cut and polished on it. Each tiny facet must be exactly the right size and shape and must be placed at exactly the right angle in relation to other facets.

During the 1400's, diamond cutters learned how to shape and polish a stone by using an iron wheel coated with diamond dust. As people learned more about diamonds, they discovered the shapes that give the greatest brilliance. The style of cut often seen today is the round shape with 58 facets, which is called the *brilliant cut*. This style of cutting was begun in the 1600's. Diamond saws cut diamond crystals with great accuracy, and so help prevent waste. See **Gem** (illustration: Types of gem cuts).

How diamonds can be judged. Gem diamonds are graded according to weight, clarity, color, and cut. The weight of a diamond is measured by the carat. The clarity of a diamond can be lessened by various kinds of flaws. Among these flaws are *inclusions* (other substances enclosed in the crystals), small bubbles, and small *fissures* (cracks), which jewelers sometimes call *feathers*. The best-quality diamonds—and the most valuable ones—are completely colorless. Very few diamonds reach this standard. Many diamonds have a yellowish tint. Other diamonds are black, blue, brown, green, pink, purple, or red. Red is the rarest color in natural diamonds. The way a diamond is cut may affect its value because a stone that is not properly proportioned lacks the brilliance of a well-cut stone.

In buying a diamond, the buyer should have the advice of a reliable dealer. Terms used to describe gem diamonds vary considerably. A *flawless diamond* should have no physical defects, such as cracks, inclusions, scratches, blemishes, or a cloudy appearance. But a flawless diamond may not be colorless. Some people consider a diamond to be perfect if it is colorless as well as flawless, has high clarity, and is correctly cut.

Cutting and polishing a rough diamond is a slow and costly process. It must be done by highly trained workers, who take many years to learn their trade.

Famous diamonds. Many large diamonds of rare quality are the property of royalty or of a government. The largest stone ever discovered was the *Cullinan*. This diamond, found in 1905 in the Premier mine of South Africa, weighed 3,106 carats, or about 1 $\frac{1}{3}$ pounds (0.6 kilogram). It was purchased by the Transvaal government and presented to King Edward VII of the United Kingdom. Transvaal was a British colony in what is now South Africa. Amsterdam cutters *cleaved* (split), cut, and polished the Cullinan into 9 large gems and 96 smaller stones. The largest cut diamond in the world came from the Cullinan. It is the 530-carat *Cullinan I* or *Star of Africa*.

In 1934, the *Jonker* diamond was found. It weighed 726 carats, and was said to be unequaled in purity. Between 1935 and 1937, the Jonker was cut into 12 flawless stones. The largest stone weighed 125 carats. The *Orloff* is a magnificent Russian crown jewel bought by Prince Orloff for the Empress Catherine II. This huge diamond is said to have been stolen from the eye of an idol in a Hindu temple. The *Koh-i-noor,* now in the British crown jewels, was for many centuries possessed by Indian and Persian rulers. The United Kingdom acquired it when the British annexed the Punjab in 1849.

The *Regent* diamond, once known as the *Pitt* diamond, is an Indian gem regarded as one of the most beautifully cut of the world's large diamonds. It is owned by the government of France and is on display in the Louvre in Paris. The blue *Hope* diamond became the property of the Smithsonian Institution in the United States in 1958.

Industrial uses. Diamonds unsuitable for cutting into gemstones are widely used in industry. Industrial-grade diamonds include stones that are imperfectly formed, contain many inclusions or other flaws, or have poor color. Manufacturers need these diamonds to shape, with great accuracy, hard metals that are used in making automobiles, airplanes, and various types of engines and other machinery. Diamonds are used in such work because of their extreme hardness. They can cut, grind, and bore very hard metal quickly and accurately. Some-

McCaffery & Co. (WORLD BOOK photo by Steinkamp/Ballogg)

$\frac{1}{2}$ carat 1 carat 1$\frac{1}{2}$ carats 2 carats 2$\frac{1}{2}$ carats 3 carats 3$\frac{1}{2}$ carats 4 carats

The size of a diamond is determined by its weight in carats. One carat equals 200 milligrams. This photo shows round diamonds of different carats and the approximate difference in their diameters. However, not all diamonds of these weights would have exactly these diameters. For example, a 4-carat diamond deeper than the one shown would have a smaller diameter.

times whole rough diamonds are set into industrial tools. Sometimes the diamonds are crushed and then baked onto cutting tools. Occasionally, diamonds are cut into special shapes before they are set into tools. Diamonds are set in the ends of drills used in mining. Very fine wire is drawn to size through diamonds in which tapering holes have been cut.

Synthetic diamonds. The demand for industrial diamonds cannot be met by the supply of natural diamonds. For this reason, industry now depends on synthetic diamonds. The world's first synthetic diamond was produced in 1954 at the General Electric Research Laboratory. Scientists made the diamond by compressing carbon under very high pressure and heat. Today, several companies manufacture industrial diamonds.

In 1970, the General Electric Company produced the first synthetic diamonds of gem quality and size. Scientists use these diamonds to research new uses for diamonds. For example, researchers have found that adding small amounts of the chemical element boron to synthetic diamonds turns them into *semiconductors*. Semiconductors are materials with special electrical properties. They are used to make transistors and other electronic equipment. Synthetic diamonds are not sold as jewelry because they cost so much to produce that, as gemstones, they would cost more than natural diamonds would.

Imitation diamonds resemble genuine diamonds. Some are natural gemstones, such as colorless varieties of spinel and zircon. Others are manufactured from substances that are similar to diamonds in appearance. These substances include glass, yttrium aluminum garnet (YAG), and cubic zirconia. A cubic zirconia is difficult to distinguish from a genuine diamond. Jewelers must use scientific tests to tell them apart. Imitation diamonds are softer than genuine diamonds and may show scratches and other signs of wear. Robert I. Gait

See also **Arkansas** (Places to visit); **Borazon; Gem; Hardness.**

Diana was a goddess in Roman mythology. She was the daughter of Jupiter, the king of the gods, and the goddess Latona. Diana and the god Apollo were twins. She was born on the island of Delos, and so she was sometimes called the Delian goddess, or Delia. Because she resembled the Greek goddess Artemis, she became associated with her myths and characteristics.

Diana was a moon goddess and the goddess of various aspects of women's life, including childbirth. She also was the goddess of young living things, particularly young animals, and of hunting. A virgin, Diana symbolized chastity and modesty. When Actaeon saw her bathing, she took revenge by changing him into a stag. His hounds immediately attacked and killed him.

Artists showed Diana wearing hunting clothes, carrying a bow and quiver of arrows, and accompanied by forest nymphs and hunting dogs. E. N. Genovese

See also **Artemis.**

Diana, Princess of Wales (1961-1997), was the wife of Prince Charles, the heir to the British throne, from 1981 to 1996. She and Charles were the parents of Prince William of Wales, second in line to the throne, and Prince Henry of Wales.

Archive Photos

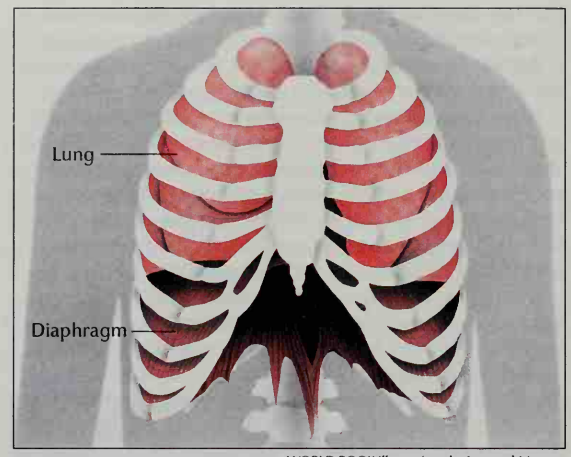
Diana, Princess of Wales

Diana came to international attention with her marriage to Prince Charles in 1981. Her activities were widely reported, and she became popularly known as "Princess Di." She supported numerous charitable causes, including AIDS research, a ban on land mines, and many causes benefiting children. Diana and Charles separated in 1992 and divorced in 1996. The princess died after an automobile accident in Paris in 1997.

Lady Diana Frances Spencer was born on the royal estate of Sandringham in Norfolk, England. Her father was the eighth Earl Spencer. Her family traces its ancestry to King James I. Diana was educated in England and Switzerland. She taught at a kindergarten in London from 1979 until 1981. Howard Timms

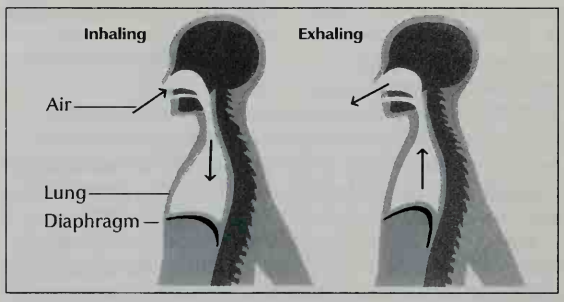
General Electric

Synthetic diamonds are produced in a press, *left*, developed by scientists in the early 1970's. Synthetic-diamond powder, *center*, is placed in the press along with a metal catalyst. The mixture then is subjected to extreme heat and pressure. The diamonds that result, *right*, have the quality and size of natural gems.



WORLD BOOK illustrations by Leonard Morgan

The diaphragm is a large, dome-shaped muscle that plays a major role in respiration. It is attached to the ribs on each side and to the breastbone in front and the lower spine in back, *above.* When a person inhales, *below left,* the diaphragm contracts and its dome flattens. This action increases the volume of the lungs, thereby creating a slight vacuum that pulls air into the lungs. When a person exhales, *below right,* the diaphragm and rib muscles relax. The stretched elastic fibers in the lung contract and cause the lung to become smaller, forcing air out.



Diaphragm, *DY uh fram,* the large muscle attached to the lower ribs, separates the chest from the abdomen. Only human beings and other mammals have complete diaphragms. The diaphragm is the chief muscle used in breathing. It is shaped like a dome.

When a person takes a breath, the diaphragm contracts and moves downward. This increases the space in the chest. At the same time, muscles attached to the ribs cause the ribs to move outward. This expands the chest, and together with the downward motion of the diaphragm, creates a slight vacuum in the chest. The vacuum causes air to enter the lungs through the windpipe. This action is called *inspiration* or *inhalation.*

During *expiration,* also called *exhalation,* air moves out of the lungs as the diaphragm and rib muscles relax. When a person breathes normally, expiration is passive and muscles do no work. The expanded lung contains elastic fibers that were stretched during inspiration. This elastic tissue behaves like stretched rubber bands, causing the lung to contract like a collapsing balloon. This forces air out of the chest. The lung gets smaller until it reaches the size at which the breath started. The lungs do not empty completely during expiration because the chest wall holds them in a partially expanded state. In hard breathing, as occurs during exercise, expiration is active. Another set of rib muscles helps to make the chest smaller. Muscles in the abdominal wall also contract to push the abdominal organs upward against the diaphragm, helping force air out of the lungs.

The *phrenic nerve* carries the electrical signals to the diaphragm that stimulate it to contract. This nerve arises from the spinal cord high in the neck and extends into the chest down to the diaphragm. Robert A. Klocke

See also **Abdomen; Chest; Lung; Respiration.**

Diarrhea, *dy uh REE uh,* is a condition characterized by loose and frequent bowel movements. The stools are usually watery and soft, and may contain mucus, pus, or blood. Nausea, loss of bowel control, and abdominal cramps frequently accompany diarrhea.

Diarrhea is usually a symptom of an intestinal disorder and not a disease itself. The most frequent cause of diarrhea is infection from food or water contaminated by viruses, bacteria, or protozoans. The body usually develops a defense against the invading agent, and diarrhea then disappears. However, diarrhea may become chronic and lead to dehydration, malnutrition, vitamin deficiencies, and a weakened immune system. Such infectious diarrhea is epidemic in many developing countries. Every year, dehydration resulting from infectious diarrhea kills millions of children worldwide. Other causes of diarrhea include *colitis* (inflammation of the colon) and intestinal cancer. Emotional disturbances, such as nervousness or fear, can also bring on diarrhea.

Treatment of diarrhea consists primarily of replacing lost body fluids and salts. A doctor should be consulted if diarrhea persists for more than a few days, or if it afflicts infants or young children, the elderly, or the severely ill. André Dubois

See also **Cholera; Colitis; Dehydration; Dysentery.**

Diary is a written account of a person's experiences and thoughts, recorded each day or every few days. Many people keep diaries as a personal record. Most do not intend that other people read their diaries.

Diaries resemble journals, and the two words are often used interchangeably. However, journals are generally less personal than diaries, and many journals are written for other people to read.

Throughout history, people have kept diaries. Some diaries provide insight into the events and customs of a particular period. One of the most famous historical diaries was written by Samuel Pepys, a British government official. Pepys's diary, written in a personal code, covers the period from 1660 to 1669. Pepys was a sociable, prosperous Londoner who made keen observations about public events. His diary includes information on the Great Plague of 1665 and the Great Fire of London, which occurred in 1666. Pepys's diary was not decoded until the early 1800's. The complete diary was first published in nine volumes during the 1970's.

The diary of William Byrd II, a wealthy landowner in colonial Virginia, vividly portrays the lives of well-to-do colonists during the 1700's. Perhaps the best-known diary of the 1900's was written by Anne Frank, a young German-Jewish girl. She and her family hid from the Nazis during World War II to avoid persecution. From 1942 to 1944, Frank kept a record of her experiences in *The Diary of Anne Frank* (1947).

Many authors of fiction have written novels and short

stories in the form of diaries. Such tales have a highly personal quality because the reader can become closely involved with the personality of the central character. The Russian author Nikolai Gogol wrote "The Diary of a Madman" (1835), a short story in the form of the diary of a clerk. In the novel *Dangling Man* (1944), the American author Saul Bellow portrays the hero of the story in the act of writing a diary. The novel consists largely of the hero's diary entries. William H. Epstein

See also **Bellow, Saul; Burney, Fanny; Byrd, William, II; Frank, Anne; Pepys, Samuel.**

Dias, Bartolomeu (1450?-1500), also spelled *Diaz,* was a Portuguese sea captain and explorer. His discovery of a sailing route around Africa helped establish travel between western Europe and Asia.

Little is known about Dias's early life. In 1481 and 1482, he commanded one of the ships in an expedition to the Gold Coast in Africa. This region now makes up the nation of Ghana.

In 1487, King John II of Portugal ordered Dias to try to sail to the southern end of Africa. The king wanted to know if ships could reach Asia by sailing around Africa. He had earlier ordered land and sea expeditions to travel to Asia, but those attempts at the journey failed.

Dias commanded a fleet of three ships that left Portugal in the summer of 1487. After reaching the mouth of the Orange River in southern Africa, a storm blew the ships out to sea. Dias and his crews did not see land for 13 days. When the storm ended, he realized that the ships had been blown around the southern tip of Africa. He sailed along the southeast shore of the continent, hoping to continue on to India. However, the sailors were exhausted by their long voyage, and their food was running low. They persuaded Dias to return to Portugal. As the expedition sailed around the tip of Africa toward Portugal, Dias sighted what is now called the Cape of Good Hope. According to tradition, he named it the *Cape of Storms.* However, King John later renamed it the Cape of Good Hope because its discovery indicated that a sea route to India would soon be found. The expedition reached Portugal in December 1488.

In 1494, Dias directed the construction of two ships for what became the first successful expedition around Africa to India. Vasco da Gama, another Portuguese explorer, led the voyage in 1497. In 1500, Dias commanded four ships in an expedition led by Pedro Álvares Cabral, also a Portuguese adventurer. Cabral's expedition consisted of 13 ships. He tried to follow da Gama's route to India, but the fleet drifted off course and reached what is now Brazil. Dias died during the voyage from Brazil when a storm sank his ship. John Parker

See also **Da Gama, Vasco; Exploration** (Reaching the tip of Africa).

Diaspora. See **Jews** (Foreign domination).

Diathermy, *DY uh THUR mee,* is a method of treating muscle and joint disorders and other diseases by creating heat energy in tissues beneath the skin. Diathermy is used chiefly to relieve such conditions as muscle aches, muscle strain, and pain and inflammation in the joints.

In diathermy, an electric current is passed through the body, generating an electromagnetic field. The tissues of the body have different resistances to the flow of electric current. This resistance causes a temperature rise in the tissues. At the same time, the tissues absorb the electromagnetic field, causing molecules in the tissues to *oscillate* (move back and forth). The oscillation of the molecules generates heat energy. It is this energy that affects the tissues, resulting in healing, relaxation of the muscles, or other therapeutic effects.

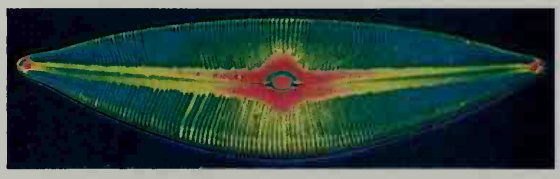
The electric current used in diathermy is an oscillating current with very high frequencies. The current oscillates so rapidly that the patient does not feel any shock. There are several forms of diathermy, each having a different range of frequencies. All forms of diathermy used for therapeutic purposes are known as *medical diathermy. Short-wave diathermy,* with frequencies in the range of radio waves, is the most commonly used form of medical diathermy. This diathermy is usually applied with two insulated metal plates, which fit against the part of the body treated. *Surgical diathermy* is used to destroy tumors and other abnormal growths. The current is concentrated at the point of a fine wire, with sufficient heat generated to kill the tissue. Mary T. Moffroid

Diatom, *DY uh tahm,* is a microscopic, single-celled organism. Diatoms are found in the ocean, in freshwater lakes, rivers, and streams, and on moist soil. In water, diatoms live attached to rocks, sand, or plants, or they may float freely. Diatoms are probably best known as part of the mass of drifting organisms in oceans called *plankton.*

Diatoms belong to a group of simple plantlike organisms called *algae.* Like green plants, diatoms can live and grow using only sunlight, water, carbon dioxide, and certain minerals.

Diatom cells contain both green and yellow-orange pigments that enable them to trap the sun's energy. This combination of pigments gives diatoms a golden-brown color. For this reason, they are sometimes called *golden-brown algae.*

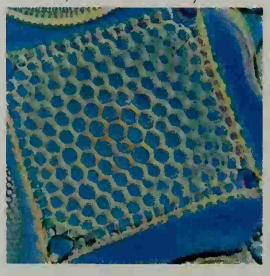
Diatoms differ from other algae in that their cells are enclosed in a hard, glasslike shell made of opal. The shell, also called the *frustule,* consists of two parts that fit one inside the other, like a box with its lid. Most diatoms are either circular or oblong in shape. Diatoms



Eric Gravé, Science Photo Library

Diatom shells show some of the possible shapes of these one-celled organisms. The edgewise view above illustrates how the halves of a diatom shell fit together. The photographs below show flat views of a square and a five-pointed diatom.

Gene Cox, Science Photo Library



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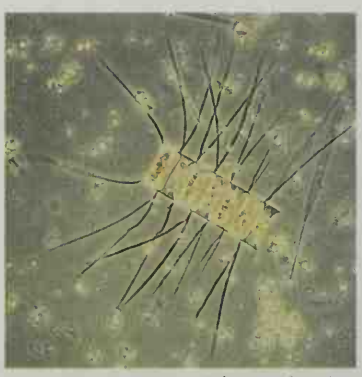
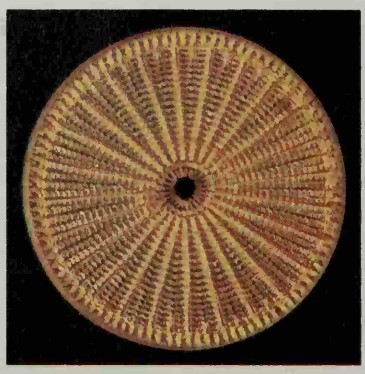


Jan Hinsch, Science Photo Library

***Chaetoceros* diatoms** link themselves together into chains.



Eric Grave, Science Photo Library

An Arachnoidiscus diatom is flat and has a circular shape.

Biophoto Association from Science Photo Library

Freshwater *meridion* diatoms join and form a delicate fanlike pattern.

usually multiply through cell division—that is, one cell divides into two cells. After a diatom cell divides, each new cell retains one part of the parent shell and builds a new part to fit into it. Some diatoms stay linked after cell division, forming chain- or ribbon-shaped colonies.

Some scientists have estimated that there may be more than 12,000 species of diatoms. Scientists identify species by examining the shells.

Planktonic diatoms are especially plentiful in certain regions of the oceans, where they serve as an important source of food for fish and other marine animals. When diatoms die, their hard shells remain intact. Eventually the shells sink to the bottom of the sea. Over thousands of years, the layer of diatom shells may become very deep. On land, the accumulation of diatom shells from ancient seabeds is mined as *diatomaceous earth,* also called *diatomite.* This substance is used as a polishing powder, abrasive, insulator, or filter. It is also used as a filler in paints and in rubber and plastic products.

Scientific classification. Diatoms have traditionally been classified in the plant kingdom, Plantae. Many scientists now classify diatoms in the kingdom Protista. David L. Garrison

See also Algae; Plankton.

Diaz, Bartolomeu. See Dias, Bartolomeu.

Díaz, *DEE ahs,* **Porfirio,** *pawr FEE rih oh* (1830-1915), served as president of Mexico from 1877 to 1880 and from 1884 to 1911. Díaz helped modernize Mexico. His policies encouraged foreign investment and the development of banking, commercial agriculture, industry, mining, railroads, and the telegraph system. A popular uprising in 1910 forced Díaz, who ruled as a dictator, into exile in France, where he died.

Díaz was born in Oaxaca, Mexico. He first gained fame as a general in the war against French invaders that lasted from 1863 to 1867. Díaz overthrew President Lerdo de Tejada in 1876 and acted as provisional president until his election in 1877. W. Dirk Raat

See also Mexico (The dictatorship of Porfirio Díaz).

Dice are small cubes used in such games of chance as craps. Dice are also used in playing backgammon, Monopoly, and other board games. A single cube is called a *die.* Each die has six sides, with each side imprinted with one to six dots. In most games, two dice are used. Players roll the dice on a craps table or other flat surface. When the dice stop rolling, the total number of dots on the top side of both dice determines the number used for that particular turn. Random chance, not skill, decides which numbers appear on the dice.

Craps is a popular gambling game in which a player rolls the dice, trying for a certain number from 2 to 12, depending on the situation. There are 36 combinations of numbers that will produce one of the 11 numbers from 2 to 12. Dwight Chuman

Dichloro-diphenyl-trichloroethane. See DDT.

Dick, Philip K. (1928-1982), was an American science-fiction writer. His works often feature common science-fiction elements, such as alien beings, alternate universes, and humanlike machines called androids. But his best works reflect his philosophical ideas and his concern with character rather than with action or gadgetry.

Dick's most popular novel, *The Man in the High Castle* (1962), is an alternate history in which the Germans and Japanese have won World War II and occupied the United States. In *Do Androids Dream of Electric Sheep?* (1968), a bounty hunter hired to kill escaped androids begins to feel sympathy for them. Later novels reflect Dick's concern with religion. In *VALIS* (1981), a character resembling the author believes he has received enlightenment from a godlike source. His other major fiction includes the novels *Dr. Bloodmoney* (1965) and *Ubik* (1969) and *The Collected Stories of Philip K. Dick* (1987).

Philip Kindred Dick was born in Chicago. His essay "Man, Android and Machine" (1976) takes up key themes in his fiction, such as reality versus illusion.

Neil Barron

Dickcissel, *dihk SIHS uhl,* is a small, colorful bird that lives primarily in the central part of the United States. It is also sometimes seen in the Eastern States. The dick-

WORLD BOOK photo by Ralph Brunke

Dice are used in games of both chance and skill. In many games, they determine the number of moves a player may take.

Hans Reinhard, Bruce Coleman Ltd.

Dickcissels are small birds that live in grasslands and alfalfa fields in the central part of the United States. The birds have grayish-brown feathers and a yellow breast.

cissel is about 6 inches (15 centimeters) long. Its plumage is a streaked grayish-brown, varied by a yellow breast and bright chestnut wing patches. There is a conspicuous black crescent on the throat. Dickcissels live in grasslands and alfalfa fields and may be seen along railroads and roadsides. The birds eat insects and seeds. The female lays from 3 to 5 eggs. The nest is built of leaves, grass, and hair, and is on or near the ground.

Scientific classification. The dickcissel belongs to the emberizid family, Emberizidae. Its scientific name is *Spiza americana.* Sandra L. Vehrencamp

See also **Bird** (picture: Birds of grasslands).

Dickens, Charles (1812-1870), was a great English novelist and one of the most popular writers of all time. His best-known books include *A Christmas Carol, David Copperfield, Great Expectations, Oliver Twist, The Pickwick Papers,* and *A Tale of Two Cities.* Dickens created some of the most famous characters in English literature. He also created scenes and descriptions of places that have long delighted readers. Dickens was a keen observer of life and had a great understanding of humanity, especially of young people. He sympathized with the poor and helpless, and mocked and criticized the selfish, the greedy, and the cruel.

Dickens was also a wonderfully inventive comic artist. The warmth and humor of his personality appear in all his works. Perhaps in no other large body of fiction does the reader receive so strong and agreeable an impression of the person behind the story.

Dickens' life

Charles John Huffam Dickens was born in Portsmouth, England, on Feb. 7, 1812. He moved with his family to London when he was about two years old. Many of the events and people in Dickens' books are based on events and people in his life. Dickens' father, John Dickens, was a poor and easygoing clerk who worked for the navy. John served in some respects as the model for Wilkins Micawber in *David Copperfield.* He spent time in prison for debt, an event that Charles re-created in *Little Dorrit.*

Even when John was free, he lacked the money to support his family adequately. At the age of 12, Charles worked in a London factory pasting labels on bottles of shoe polish. He held the job only a few months, but the misery of that experience remained with him all his life.

Dickens attended school off and on until he was 15, and then left for good. He enjoyed reading and was especially fond of adventure stories, fairy tales, and novels. He was influenced by such earlier English writers as William Shakespeare, Tobias Smollett, and Henry Fielding. However, most of the knowledge he later used as an author came from his observation of life around him.

Dickens became a newspaper reporter in the late 1820's. He specialized in covering debates in Parliament and also wrote feature articles. His work as a reporter sharpened his naturally keen ear for conversation and helped develop his skill in portraying his characters' speech realistically. It also increased his ability to observe and to write swiftly and clearly. Dickens' first book, *Sketches by Boz* (1836), consisted of articles he wrote for the *Monthly Magazine* and the London *Evening Chronicle.* These descriptions, fictional portraits, and short stories surveyed manners and conditions of the time.

Literary success. Dickens won his first literary fame with *The Posthumous Papers of the Pickwick Club.* Published in monthly parts in 1836 and 1837, the book describes the humorous adventures and misadventures of a group of slightly eccentric characters in London and the English countryside. After a slow start, *The Pickwick Papers*—as the book is usually called—gained a popularity seldom matched in the history of literature. At 24, Dickens suddenly found himself famous. He remained so until his death.

Dickens founded and edited two highly successful weekly magazines. He edited *Household Words* from 1850 to 1859 and *All the Year Round* from 1859 to his death. As a public figure, Dickens was constantly in the news, and was recognized and honored wherever he went. He was famous in America as well as in Britain, and he toured the United States in 1842 and in 1867 and 1868.

Personal life. Personal unhappiness marred Dickens' public success. In 1836, he married Catherine Hogarth. Catherine had a sister Mary, who died in 1837. Dickens' grief at Mary's death has led some scholars to believe that he loved Mary more than his wife. Catherine was a good woman but lacked great intelligence. She and Dickens had 10 children. The couple separated in 1858.

Dickens had remarkable mental and physical energy. He recorded his activities in thousands of letters, many of which make delightful reading. He spent much of his crowded social life with friends from the worlds of art and literature. Dickens enjoyed drama and went to the theater as often as he could. When he was rich and famous, he made a hobby of producing and acting in amateur theatrical productions. He had great success giving public readings of his works. Dickens' gift for creating dramatic scenes in his novels can be traced to his love for the theater.

Besides writing, editing, and touring as a dramatic reader, Dickens busied himself with various charities. These charities included schools for poor children and a loan society to enable the poor to move to Australia. Dickens often walked for hours to work off his remain-

The Dickens Fellowship, London

Charles Dickens, the most famous English writer of his time, enchanted audiences with dramatic readings from his novels.

ing energy. He came to know the streets and alleys of London better, perhaps, than any other person of his time.

Dickens' health began to decline about 1865 and he died of a stroke on June 9, 1870.

Dickens' books

Dickens wrote 20 novels (including 5 short Christmas books), and many sketches, travel books, and other nonfiction works. Not all of his books were best sellers, but the most popular ones broke all sales records for the time. Most of his novels were published in sections.

The first phase. After the success of *The Pickwick Papers,* Dickens turned to more serious themes and plots. However, he always introduced enough humor to keep his books entertaining.

Oliver Twist (1837-1839) describes the adventures of a poor orphan boy. The book was noted for its sensational presentation of London's criminal world and for its attack on England's mistreatment of the poor.

In *Nicholas Nickleby* (1838-1839), Dickens criticized greedy proprietors of private schools, who treated students brutally and taught them nothing.

The Old Curiosity Shop (1840-1841) is less respected today than when it was first published, largely because the death scene of Little Nell seems sentimental to modern tastes.

Barnaby Rudge (1841) is a historical novel that deals with a series of riots in London in 1780. *Martin Chuzzlewit* (1843-1844) is one of two books that Dickens based on his first trip to America. The other is the travel book *American Notes* (1842). Dickens intended *Martin Chuzzlewit* to be a study of many forms of selfishness. But it is best known for its unflattering picture of the crudeness of American manners and for its comic characters. Two of its finest creations are the hypocrite Pecksniff and the chattering, alcoholic midwife Sairey Gamp.

Dickens wrote his five "Christmas books" during the 1840's. The first, *A Christmas Carol* (1843), is one of the most famous stories ever written. In the book, three ghosts show the old miser Ebenezer Scrooge his past, present, and future. Realizing that he has been living a life of greed, Scrooge changes into a warm and unselfish person. The other Christmas books are *The Chimes* (1844), *The Cricket on the Hearth* (1845), *The Battle of Life* (1846), and *The Haunted Man* (1848).

The second phase. During the 1840's, Dickens' view of Victorian society, and perhaps of the world, grew darker. His humor became more bitter, often taking the form of biting satire. His characters and plots seemed to emphasize the evil side of human experience.

At the same time, Dickens increasingly refined his art. The range of his tone widened and he paid more attention to structure and arrangement. He turned to symbolic themes to help express and expand his observations on topical political and social issues and on larger matters of morality and values. The unhealthy London fog in *Bleak House,* for example, symbolizes the illness of society, especially its lack of responsibility toward the downtrodden and the unfortunate.

Dombey and Son (1846-1848) deals primarily with a selfish egotist whose pride cuts him off from the warmth of human love. The book stresses the evils of the Victorian admiration for money. Dickens believed that money had become the measure of all personal relations and the goal of all ambition.

With *David Copperfield* (1849-1850), Dickens temporarily lessened the role of social criticism to concentrate more on semiautobiography. The novel describes a young man's discovery of the realities of adult life. David's youth is clearly patterned after Dickens' youth.

Bleak House (1852-1853) is in many respects Dickens' greatest novel. It has a complex structure and many levels of meaning, mixing melodrama with satire and social commentary. The book deals with many social evils, chiefly wasteful and cruel legal processes. It also attacks the neglect of the poor, false humanitarians and clergymen, and poor sanitation.

This long novel was followed by the much shorter and simpler *Hard Times* (1854). *Hard Times* attacks philosopher Jeremy Bentham's doctrine of *utilitarianism.* Bentham believed that all human ideas, actions, and institutions should be judged by their usefulness. Dickens was convinced that Bentham reduced social relations to problems of cold, mechanical self-interest.

In *Little Dorrit* (1855-1857), Dickens continued his campaign against materialism and snobbery, which were represented by the rich Merdle family and their social-climbing friends. He also ridiculed government inefficiency in the form of the "Circumlocution Office." The prison, like the fog in *Bleak House,* is symbolic. It stands for the painful conditions of life in a materialistic, decaying society.

A Tale of Two Cities (1859) was the second of Dickens' two historical novels. It is set in London and Paris and tells of the heroism of fictional Sydney Carton during the French Revolution.

In *Great Expectations* (1860-1861), Dickens returned to the theme of a youth's discovery of the realities of life. An unknown person provides the young hero Pip with money so that Pip can live as a gentleman. Pip's pride is shattered when he learns the source of his "great expec-

tations." Only by painfully revising his values does Pip reestablish his life on a foundation of sympathy, rather than on vanity, possessions, and social position.

Our Mutual Friend (1864-1865) was Dickens' final novel of social criticism. Dickens again attacked the false values of the newly rich. He satirized greed, using the great garbage heaps of the London dumps as a symbol of filthy money. The novel is also notable for its suggestive use of London's River Thames.

Dickens had completed about one-third of his novel *The Mystery of Edwin Drood* when he died. Nobody knows how Dickens intended the story to end. Scholars and readers throughout the years have proposed many possible solutions for the mystery.

Dickens' place in literature

Dickens is now considered one of the major figures in English literature, but his position was not always so high. His reputation declined between 1880 and 1940. This was partly due to the psychological emphasis that became fashionable in novels after Dickens' death. Critics valued Dickens chiefly as an entertainer and, above all, as a creator of a huge gallery of comic, pleasant, and villainous characters. They recognized him as a master creator of plot and scene, and as a sharp-eyed observer of London life. But they considered his outlook simple and unrealistic. They believed he lacked artistic taste and relied too much on broad comedy, dramatic effects, sentimentality, and superficial psychology.

However, since 1940, numerous books and essays have described Dickens as a writer of considerable depth and complexity. He has also been praised as a sensitive and philosophic observer of human struggles within social institutions. In this sense, Dickens has been associated with such authors as Herman Melville, Franz Kafka, and Fyodor Dostoevsky.

Recent criticism has demonstrated that Dickens can no longer be regarded only as an entertainer, though his ability to entertain is probably the major reason for his popularity. Whatever his other claims to greatness may be, Dickens ranks as a superbly inventive comic artist. His characters have been compared to those of Shakespeare in their variety, color, energy, and life. Dickens was aware of human evil, but he never lost his perspective. Dickens' art was sustained by an awareness and appreciation of the human comedy. K. K. Collins

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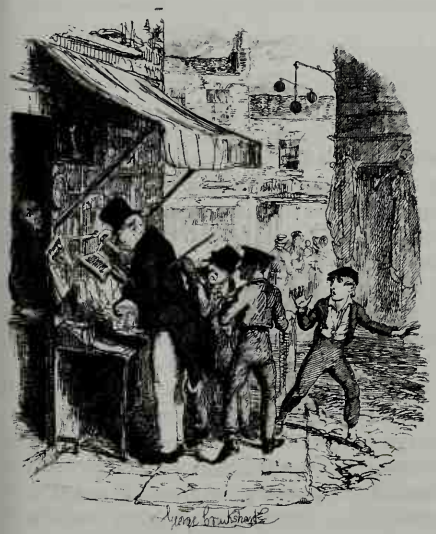
Dickey, James (1923-1997), was an American poet and novelist. He is known chiefly for works that portray people testing their survival instincts against other people and nature. Some of his writings explore people's animal instincts, which include killing for enjoyment. Dickey shows people learning about the brutal side of human nature.

Dickey's novel *Deliverance* (1970), written in a clear, matter-of-fact style, tells about a middle-class businessman who must struggle to survive in the wilderness. In his fight to survive, he has to kill another man. This experience teaches him that cruelty is part of people's nature. Many of Dickey's writings are based on episodes from his own life. Some of his works, particularly the poem "The Firebombing" (1964), reflect his experiences as a combat pilot. The pilot in this poem feels a sense of

Oliver Twist* and *David Copperfield contain many popular Dickens characters. In *Oliver Twist,* an original illustration by the artist George Cruikshank shows Oliver watching in alarm as the Artful Dodger and Charley Bates pick Mr. Brownlow's pocket. In *David Copperfield,* David, Betsy Trotwood, and Mr. Dick watch the joyful reunion of Wilkins Micawber and his family. Hablot Knight Browne, popularly known as Phiz, drew this illustration for the first edition of the novel.

Collection of Mr. and Mrs. David Bradford, Chicago



power at killing, but no sorrow. Dickey's novel *Alnilam* (1987) is a rich and intricate story about a father's search for his son.

Dickey was born in Atlanta, Ga. His poetry is collected in *Buckdancer's Choice* (1965), *Poems 1957-1967* (1967), and *The Strength of Fields* (1980). A number of his prose pieces were published in *Sorties: Journals and New Essays* (1971) and *Night Hurdling* (1983). Marcus Klein

Dickinson, Anna Elizabeth (1842-1932), was an orator of the Civil War period who spoke on abolitionism and women's rights. Woman orators were a novelty at that time, and she became known as the North's "Joan of Arc." She attracted large crowds with her emotional pleas to end slavery.

Dictionary of American Portraits

Anna E. Dickinson

Dickinson was born in Philadelphia. She gave her first important speech in 1860, the year before the Civil War began, when she addressed the Pennsylvania Anti-Slavery Society. Dickinson was then only 18 years old. In 1861, she spoke on the "Rights and Wrongs of Women." In 1864, she denounced the South in a speech to members of the U.S. Congress and President Abraham Lincoln.

After the Civil War, Dickinson frequently lectured on feminism and blacks' rights. She spoke for organizations called *lyceums,* which sponsored adult education programs. During some years, she earned as much as $20,000, a large income for anyone of her day.

Dickinson's speaking career declined in the early 1870's. She campaigned for the Democratic Party in 1872, and for the Republicans in 1888. She spent her last 40 years in seclusion. Nancy Spelman Woloch

Dickinson, Emily (1830-1886), was an American poet. Dickinson and Walt Whitman are considered the two most gifted poets in American literature. Like Whitman, she was influenced by the writings of American author Ralph Waldo Emerson. In her verses, Dickinson expressed Emerson's late pessimism. Many of her poems reflect the alienation of American intellectuals after the Civil War (1861-1865).

Her life. Emily Dickinson was born in Amherst, Mass., on Dec. 10, 1830. She was reclusive, and much about her is unknown. She never married, and after turning 30, seldom saw anyone other than her immediate family.

Dickinson's seclusion from society has fascinated her readers. Scholars believe that she chose to think and write in, as she wrote, "her own Society," rather than in the narrow-minded literary establishment of her time. This establishment expected female writers to confine themselves to domestic subjects and sentimental observations. Furthermore, an unmarried professional woman in America had few opportunities in the 1800's. Therefore, Dickinson chose to remain in her comfortable, upper-middle-class home. Although her choice no longer seems so strange, people in her town viewed her as a curiosity and finally resented her unavailability.

Dickinson always wrote as what she called the "supposed person." This person never tired of examining the unique facts of existence. Hidden away on the second story of her parents' home, she analyzed practically every aspect of nature in poems that she began to bind into small books that were called *fascicles.*

The Trustees of Amherst College, Amherst, Mass.

Emily Dickinson

At about the age of 30, Dickinson began to look intensely at life itself, rather than looking for the normal expectations of life. While the Civil War raged, she produced the most and best of her poems. The poet continued to write in the 1870's but at a much slower pace. Probably one of her best poems, however, was written in this period of decline. Called "A Route of Evanescence," it describes the fluttering ascent of a hummingbird. For Dickinson, this erratic ascent was also the route of experience. Life was finally inscrutable, and its joy was to be found in studying its paradoxes.

Her poems. Dickinson wrote over 1,700 poems, but scholars generally agree she did not wish to publish any of them. But at least 10 of her poems appeared in print during her lifetime without her permission. One of them, "Success Is Counted Sweetest," teaches that experience resides in the ratio between success and failure rather than in either of the two exclusively.

The mere experience of being alive dominates Dickinson's poetry. Her poems show how Dickinson was sensitive to both the ecstasy and the anguish of everyday experience. In "A Narrow Fellow in the Grass" her crisp imagery conveys the sudden and flashing fear of coming upon a snake in the tall grass:

> Yet when a Boy, and Barefoot—
> I more than once at Noon
> Have passed, I thought, a Whip lash
> Unbraiding in the Sun

Dickinson daily dressed in white, as if to mock the traditions of marriage. She often pondered the consequences of her life style:

> I'm "Wife"—I've finished that—
> That other state—
> I'm Czar—I'm "Woman" now—
> It's safer so—

The "lover" in many of her poems is not a potential husband and "master" but death and eternity. In what many critics believe is her greatest poem, "Because I Could Not Stop for Death," a carriage that brings her gentleman caller holds "but just Ourselves/And Immortality."

The point of view of most of her poems reinforces her theme that our most important moments are over as soon as they begin. Dickinson's "I Heard a Fly Buzz" reflects this theme, describing with beauty and simplicity a dying person's impressions at the moment of death. This poem appears in the **Poetry** article.

Often her poems open with a clear story line, but quickly fade at their close into silence, as if to suggest her inquiry continues in the subconscious. As she wrote

in another poem, it was the poet's job to distill "amazing sense/from ordinary meaning." Jerome Loving

See also American literature (The Era of Expansion [1831-1870]

Additional resources

Kirkby, Joan. *Emily Dickinson.* St. Martin's, 1991.
Sewall, Richard B. *The Life of Emily Dickinson.* 1974. Reprint. Harvard Univ. Pr., 1994.

Dickinson, John (1732-1808), represented Delaware at the 1787 Constitutional Convention in Philadelphia and played an important role in drafting the Constitution of the United States. Illness forced Dickinson to leave the convention early, but he authorized another delegate to sign the Constitution for him. At the convention, Dickinson supported a strong national government. However, he also defended the rights and powers of the states against those of the federal government. He was among several delegates who first raised the idea of a dual legislature that would give states both equal and population-based representation.

Dickinson was born in Talbot County, Maryland. He studied law in Philadelphia and London. In 1767 and 1768, Dickinson wrote a series of newspaper articles that expressed the American Colonies' resistance to British taxation. The series was published later in a pamphlet titled *Letters from a Farmer in Pennsylvania to the Inhabitants of the British Colonies.* Dickinson's writings earned him the nickname "Penman of the Revolution."

Dickinson opposed the Declaration of Independence and was among the members of the Second Continental Congress who refused to sign it. However, he proved his patriotism by joining the American army in the Revolutionary War in America (1775-1783) and by helping write the Articles of Confederation. Dickinson was prominent in both Delaware and Pennsylvania. He was president of Delaware in 1782 and 1783 and of Pennsylvania from 1782 to 1785. Barbara E. Benson

Dickson, Brian (1916-1998), served as chief justice of the Supreme Court of Canada from 1984 to 1990. He was appointed by the government headed by Prime Minister Pierre Trudeau and had served as a *puisne* (associate) judge of the court since 1973. On constitutional issues, he showed concern for maintaining a well-balanced federal system in Canada.

Robert George Brian Dickson was born in Yorkton, Saskatchewan. He earned a law degree from the University of Manitoba. During World War II, he served in Europe with the Royal Canadian Artillery from 1940 to 1945. He lost most of his right leg in battle. After the war, Dickson practiced law in Winnipeg. He was appointed to the Manitoba Court of Queen's Bench in 1963 and to the Manitoba Court of Appeal in 1967.

Under Dickson, the Supreme Court decided the first cases on the basis of the Canadian Charter of Rights and Freedoms. This bill of rights took effect in 1982. As chief justice, Dickson took a liberal approach. In 1988, he was among the five-judge majority that rejected Canada's restrictive abortion law. Peter H. Russell

See also Supreme Court of Canada.

Dicotyledon, *dy KAHT uh LEE duhn,* is a type of flowering plant that has two *cotyledons* (leafy parts within each seed). Dicotyledon plants have leaves with netted veins. Their flower petals usually grow in multiples of 4 or 5. Common dicotyledons include beans, peas, squashes, and tomatoes. See also Cotyledon.

Dictating machine is a device that records speech onto a magnetic medium such as a tape or disk. A typist can later play back the recording and type it on a typewriter or input it into a computer. Some dictating machines are small enough to fit in a jacket pocket. Others are desktop machines. Many offices have centralized dictating systems, machines that can record messages dictated over telephones.

To use a dictating machine, a person speaks into a microphone or telephone, which translates the sound waves into electric current. The dictating machine then translates the current into a pattern of magnetization on the magnetic medium. Some machines create an *analog pattern*—one that is similar to the sound waves. Most of these machines create this pattern on a cassette tape. Other machines translate the current into a digital (numerical) pattern on a hard disk. *See* Tape recorder.

To listen to the dictation, a typist puts the cassette into a *transcriber* or uses a *transcription unit* to obtain information from the hard disk. The transcriber or transcription unit translates the magnetic pattern back into sound waves. Eileen Feretic

Dictatorship is a form of government in which an individual, a committee, or a group holds absolute power. The term *dictator* originated in ancient Rome. The Roman Senate often appointed individuals as temporary "dictators" who could handle national emergencies without the approval of the people or the Senate. But the Roman dictator did not have the absolute power of modern dictators. Today, many countries are ruled by dictatorships, including some Communist nations.

Dictatorship is similar to *absolute monarchy,* another system of government in which the rulers have no legal restrictions on their power. However, the two systems differ. Throughout history, most people have accepted monarchies as a form of government. Once established, monarchies tended to become hereditary. Most monarchs respected the established customs and institutions of countries they ruled and often shared power with other government officials and nobles. Dictatorships, on the other hand, generally lack the approval of the people and are almost never hereditary. Dictators also maintain exclusive control over the government.

Most dictatorships are established through violence, force, and sometimes political trickery. Joseph Stalin used these methods while serving as general secretary of the Communist Party in the Soviet Union, and he became dictator of the country in 1929. Dictators must continue to use force to maintain their power. Thus, most dictators outlaw or limit freedom of speech, assembly, and the press. Many dictators also forbid elections entirely. Many others change the votes or force people to vote for candidates chosen by the government. In spite of denying their citizens numerous basic freedoms, however, many dictatorships call themselves "people's republics" or "people's democracies."

Some dictatorships develop after a country has been conquered by a foreign power. The Soviet Union controlled much of Eastern Europe following World War II (1939-1945), and Stalin established Communist dictatorships in Poland, Czechoslovakia, and other nations in that region. A dictatorship may also take over a demo-

cratic nation during a period of crisis. The crisis may divide the government and limit its ability to maintain domestic order, security, and prosperity. Dictators who came to power under such circumstances included Benito Mussolini of Italy in 1922, Adolf Hitler of Germany in 1933, Francisco Franco of Spain in 1939, and Augusto Pinochet of Chile in 1973. Alexander J. Groth

See also **Autocracy; Government.**

Additional resources

Axelrod, Alan, and Phillips, Charles. *Dictators and Tyrants.* Facts on File, 1995.

Blackwood, Alan. *Twenty Tyrants.* Cavendish, 1990. Younger readers.

Brooker, Paul. *Defiant Dictatorships.* N.Y. Univ. Pr., 1997.

Dictionary is a reference work that contains a selected list of words arranged in alphabetical order. It explains their meanings and gives information about them. In a dictionary, a person can look up a word quickly, discover what it means, and learn how it is pronounced.

Most modern dictionaries describe the facts of a language as educated speakers and writers use it. They are called *descriptive dictionaries* because a dictionary editor does not change the facts of a language. A large number of older dictionaries tried to prescribe rules, some of which did not agree with the way people commonly talked or wrote. These books are called *prescriptive dictionaries.*

What dictionaries contain

Dictionaries give the meanings of many kinds of words. Most general dictionaries include (1) the ordinary words of everyday life, such as *bread, run,* and *with;* (2) literary words used in formal writing, such as *aggregation, despoil,* and *incontrovertible;* (3) technical words, such as *starboard, gene,* and *ratio;* (4) words used chiefly on informal occasions, such as *gab* and *wimp;* (5) words used in writing to give an old-fashioned flavor, such as *aweary* and *avaunt;* (6) words not used today but found in the writings of some authors, such as *plaister* for *plaster;* (7) words or phrases from other languages, such as *coup d'état* from French, *tofu* from Japanese, and *barrio* from Spanish; (8) *idioms* (groups of words with meanings different from their literal meanings), such as *split hairs* and *under the thumb of;* (9) abbreviations, such as *U.S.A., Kans.,* and *p.;* and (10) important proper names, such as *Buddha* and *Jupiter.*

No dictionary records all the words of any language. In fact, no one knows exactly how many words there are. Besides ordinary words used in everyday speech, languages include thousands of geographical names. There are thousands of words that are no longer used. And there are hundreds of thousands of technical terms, including more than 750,000 names of insects alone. New words are coined for new scientific and technical discoveries, and slang words and special vocabularies constantly spring up. As nations draw closer together through trade and travel, Internet and satellite communication, and sharing of technology, languages tend to borrow more and more words from each other. That is why dictionary editors must be selective in the words they decide to include.

Most dictionaries tell us much more than just the meanings of words. Many list pronunciations, derivations, prefixes and suffixes, illustrative quotations, synonyms and antonyms, usage notes, and other information. The illustration with this article shows in detail what dictionaries tell us.

Kinds of dictionaries

Dictionaries may be classified as *general dictionaries* and *specialized dictionaries.* A general dictionary contains information on everyday words such as *automobile* and *grandfather.* But it also defines many technical terms such as *chromatography* and *columella.* A specialized dictionary omits most everyday terms, and limits itself to information on words used in a particular field, such as biology.

General dictionaries range in size from small pocket dictionaries to large multivolume or table dictionaries. The number of entries in a general dictionary depends on its purpose. Each dictionary is designed to answer the questions of a certain type of reader. A sixth-grade student, for example, would not want all the information given in a dictionary a college professor would use. For this reason, dictionary editors work hard to design their products to suit the needs of their intended audiences. They know that the usefulness of any dictionary depends on the education of the user and the kind of information the user wishes to find.

A general dictionary may be designed for use by elementary-school students, high-school students, or college students. It may also be designed for use by the general reader, or even by the entire family. *The World Book Dictionary* is an example of a dictionary designed for family use.

The largest general dictionaries may contain over 400,000 entries. A dictionary of this size includes many obsolete and technical terms. Other general dictionaries of more limited scope may have from 15,000 entries to 200,000 entries.

Specialized dictionaries are designed to give more information in particular fields than general dictionaries can. A *gazetteer* (geographical dictionary) lists the names of cities, countries, islands, lakes, and other places. It gives the pronunciation of each name and a brief description. A *biographical dictionary* lists and gives the pronunciation of the names of important people. Each entry includes birth and death dates, nationality, and why the person is remembered. A *thesaurus* contains lists of synonyms and antonyms. Other specialized dictionaries are devoted to usage; idioms; pronunciations; slang; spelling; new words and meanings; and various aspects of science and technology. Research or scholarly dictionaries may cover the vocabulary of earlier periods of a language, such as Old English or Late Latin. Some are also devoted to various dialects, such as Scottish or South African English. There are dictionaries of all the major languages. *Bilingual dictionaries* translate the words of one language into another.

How to use a dictionary

Before using a dictionary, one should become familiar with the methods, principles, and scope of the book because various dictionaries are arranged in different ways. Many American dictionaries arrange all entries in a single alphabetical list. Others put abbreviations, geographical and biographical names, and foreign words and phrases in separate lists, usually at the end of the

What a dictionary tells you

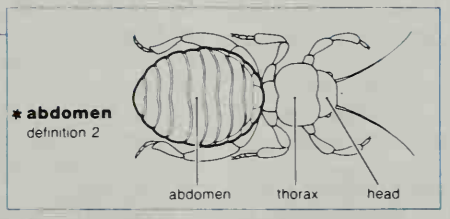
In addition to defining words, a dictionary provides much useful information about them. You can get the most out of a dictionary by learning what its abbreviations and symbols stand for. These examples come from *The World Book Dictionary.*

Word entries begin in bold black type. Only proper nouns are capitalized. The first letter of the entry extends into the margin for easy location. This dictionary uses an asterisk to indicate that the entry is accompanied by an illustration.

***ab do men** (ab′də mən, ab dō′-), *n.* **1a** the part of the body containing the stomach and the intestines; belly. In man and other mammals the abdomen is a large cavity between the chest (thorax) and the pelvis, and also contains the liver, pancreas, kidneys, and spleen. **b** a corresponding region in vertebrates below mammals. **2** the last of the three parts of the body of insects and many other arthropods, including spiders and crustaceans. [< Latin *abdōmen*]

Definitions give the precise meanings of words. If a word has more than one meaning, the definitions are numbered. This dictionary lists the most common meanings first. Some dictionaries present definitions in historical order, with the earliest meanings first.

Illustrations clarify the definitions. Labels show which meaning of the word is illustrated.



***abdomen**
definition 2

Pronunciations are given in phonetic symbols. This dictionary has a key to its phonetic symbols at the bottom of each right-hand page, with more detailed information at the front of the book.

ab dom i nal (ab dom′ə nəl), *adj.* of the abdomen; in the abdomen; for the abdomen: *Bending the body exercises the abdominal muscles.* **SYN:** ventral, visceral. — **ab dom′i nal ly**, *adv.*
abdominal brain, = solar plexus.
ab dom i nous (ab dom′ə nəs), *adj.* = potbellied.

Examples point out how the word is used in phrases or sentences.

Cross-references show that the form consulted is less widely used than some other form, which has its own main entry.

a bide[1] (ə bīd′), *v.* **a bode** or **a bid ed, a bid ing.** — ***v.t.*** **1** to put up with; endure; tolerate: *A good housekeeper can't abide dust. She can't abide him.* **SYN:** bear, stand. **2** to await submissively; submit to; sustain: *He must abide his fatal doom* (Joanna Baillie). **3** to await defiantly; withstand: *He soon learned to abide ... terrors which most of my bolder companions shrank from encountering* (Hugh Miller). **4** *Archaic.* to wait for; await: *I will abide the coming of my lord* (Tennyson).

Parts of speech labels show the word's grammatical use. Any word used as more than one part of speech is defined accordingly. The parts of speech are abbreviated, as in *adj.* for *adjective* and *n.* for *noun.* Verbs are shown as transitive (*v.t.*) or intransitive (*v.i.*).

— ***v.i.*** **1** to stay; remain; wait: *Abide with me for a time. I'll call upon you straight: abide within* (Shakespeare). *He within his ships abode the while* (William Cowper). **2** to continue to live (in a place); reside; dwell: *No martin there in winter shall abide* (John Dryden). **3** to continue (in some state or action): ... *ye shall abide in my love* (John 15:10). **4** to continue in existence; endure: *Thou hast established the earth, and it abideth* (Psalms 119:90). **SYN:** last. **5** *Archaic.* to be left. **6** *Obsolete.* to stay behind.

Other forms of the word include the principal parts of verbs, unusual plural forms, and comparative forms for adjectives.

Quotations from well-known authors or publications illustrate the meaning of the word. The sources of quotations are identified.

Usage labels, such as *Slang, Informal, Archaic,* and *Obsolete,* indicate when and where the word is acceptable in current English usage. Each label is defined in a list at the front of the dictionary.

abide by, **a** to accept and follow out; be bound by: *Both teams will abide by the umpire's decision.* **b** to remain faithful to; stand firm by; be true to; fulfill: *Abide by your promise.*

Phrases that include the key word but have special meanings of their own are explained separately.

a bil i ty (ə bil′ə tē), *n., pl.* **-ties.** **1** the power to do or act: *the ability to think clearly. The old horse still has the ability to work.* **SYN:** capability, capacity. **2** skill: *Washington had great ability as a general.* **3** power to do some special thing; natural gift; talent: *Musical ability often shows itself early in life.* [< Middle French *habilité,* learned borrowing from Latin *habilitās* aptness < *habilis* able]

Synonyms that have the same or nearly the same meaning as the defined words appear immediately after the definition.

— ***Syn.*** **2, 3 Ability, talent** mean special power to do or for doing something. **Ability** applies to a demonstrated physical or mental power to do a certain thing well: *She has developed unusual ability as a dancer.* **Talent** applies to an inborn capacity for doing a special thing: *a child with a remarkable talent for painting.*

Synonym studies explain in detail the various shades of meaning of some synonyms. All these studies include examples.

▶ After **ability** the infinitive of a verb preceded by *to* is used, rather than the gerund preceded by *of: A lawyer needs the ability to think clearly,* not *of thinking clearly.* The preposition used after *ability* and before a noun is *in: ability in music.*

Usage notes explain points of spelling or grammar and advise how to use the word in speaking or writing.

A bim e lech (ə bim′ə lek), *n.* a son of Gideon who was set up as king of Israel by the people of Shechem (in the Bible, Judges 9).
ab init., ab initio.
ab in i tio (ab′ i nish′ē ō), *Latin,* from the beginning: *The decree was not a nullity in the sense of being void ab initio* (London Times).

Etymologies tell what language or languages a word comes from, usually with its meaning in the original language. The symbol < means *comes from.*

Foreign words and phrases in common use in English have entries that give their pronunciation and translation, often with examples or illustrative quotations.

book. All good dictionaries today have introductory sections that explain what the book contains and how it is arranged.

The first thing a dictionary entry shows is how to spell a word and how to divide it into syllables. Accent marks and symbols that are explained in the book tell how to pronounce the word. Many dictionaries also tell what part of speech the word is. For example, they list *boy* as a *noun,* and *speak* as a *verb.*

Definitions of the word usually follow. Some dictionaries list the most commonly used meaning of the word first. Others arrange the meanings historically, so that the first meaning listed is the one that occurred first in the language. Some dictionaries also use the word in a sentence or phrase to help define it. Sometimes pictures or drawings are added to provide more information about the entry.

After the definitions, many dictionaries include a list of *synonyms,* or words with about the same meaning as the words being defined. Other information is often included about *etymology* (the history or origin of a word). Many dictionaries also have usage labels, such as *Slang* and *Dialect;* subject labels, such as *Biology* or *Electronics;* and regional labels, such as *British* or *U.S.* In addition, usage notes explain important points about the way a word is commonly used.

History

The word *dictionary* comes from the medieval Latin word *dictionarium,* which in turn came from the Latin *dictio,* meaning *word* or *saying.* The ancient Greeks and Romans were the first to produce these works. But most Greek and Latin dictionaries were either lists of rare and difficult words or specialized lists of words.

During the Middle Ages, scholars made much use of Latin dictionaries which explained hard Latin words in easier Latin. Toward the end of the Middle Ages, as Latin began to lose ground to English, French, German, and other national languages of Europe, scholars began to rely on *glossaries* to understand Latin manuscripts. The glossaries usually gave the meanings of hard Latin words in the words of the national language. As these languages became accepted, people needed new dictionaries to explain the hard words of their own language in terms of simpler words in the same language.

Early English dictionaries. In 1604, Robert Cawdrey, a schoolmaster, prepared the first English dictionary. Called *A Table Alphabeticall of Hard Wordes,* it defined about 3,000 English words that had been taken from other languages. Larger dictionaries that offered more information about the words they contained were produced in the 1600's. In 1721, Nathan Bailey published a dictionary containing about 60,000 words. This was the first English dictionary that tried to include most English words instead of hard words only.

In the early 1700's, Jonathan Swift, Alexander Pope, Joseph Addison, Samuel Johnson, and other literary men of England wanted to prepare a dictionary that would set the standard for good usage in English. French and Italian scholars had already published such prescriptive dictionaries in their languages, and this success influenced the literary men of England.

Samuel Johnson undertook the task of preparing an English dictionary. He spent several years selecting quotations from the best writers to illustrate the meanings of words. He came to the conclusion that language could not be "fixed" or prescribed, only described to the best of one's ability. Johnson finally published his great work, *A Dictionary of the English Language,* in 1755. With John Walker's *Critical and Pronouncing Dictionary and Expositor of the English Language* (1791), it served as the standard for information about English words until the mid-1800's.

In 1806, Noah Webster published a small school dictionary in the United States. Webster wanted to set up an American standard of good usage to compare with the British standard set by Johnson and Walker. In his dictionary, Webster simplified many older spellings, such as *music* for *musick.* In 1828, Webster published a dictionary containing 70,000 entries. Since then, Webster's dictionaries have been frequently revised and are widely used today.

Modern dictionaries. The period of national dictionaries gave way to scholarly dictionaries in the mid-1800's. In Germany, the brothers Jakob and Wilhelm Grimm began work on a historical dictionary of the German language. In France, Émile Littré compiled a dictionary of modern French. In England, John Ogilvie edited a dictionary that later served as the basis of *The Century Dictionary.* Various current English dictionaries trace their development back to *The Century Dictionary.*

Probably the greatest scholarly dictionary to appear in any language is *A New English Dictionary on Historical Principles.* It appeared in parts from 1884 to 1928 and has almost 415,000 entries. In 1933, it was published in 12 volumes, with a one-volume supplement, as the *Oxford English Dictionary (O.E.D.).* This dictionary gives a historical record of each word in written English. No other dictionary in any language approaches the *O.E.D.* in wealth and authority of historical detail. In 1989, a 20-volume second edition of the *O.E.D.* was published that integrated the 1928 edition with four supplementary volumes issued between 1972 and 1986. The historical method used to compile the *O.E.D.* was also used in making *A Dictionary of Canadianisms* (1967) and the *Dictionary of Jamaican English* (1967).

Current dictionaries sold in the United States and Canada include *Webster's Third New International Dictionary,* with about 450,000 entries, the most complete modern American dictionary of the English language. *The World Book Dictionary,* which consists of more than 248,000 definitions, is designed for family use. It was the first dictionary especially designed to be used with a specific encyclopedia.

Many dictionary publishers offer basic, intermediate, and high school dictionaries that contain from as few as 18,000 to as many as 100,000 entries. College dictionaries have about 150,000 entries. Some publishers have also adapted dictionaries for computer use. Dictionaries are also being published in electronic form as compact discs.

Patricia A. Moody

Related articles. See the separate articles in ***World Book*** on each letter of the alphabet. See also:

Abbreviation
Antonym
Capitalization
Etymology
Grammar
Johnson, Samuel
Language
Linguistics
Parts of speech
Pronunciation
Punctuation
Roget, Peter Mark
Spelling
Synonym
Thorndike, Edward Lee
Webster, Noah

Diderot, *DEE duh roh,* **Denis,** *duh NEE* (1713-1784), was a major French philosopher of an intellectual movement called the Age of Reason. His work included fiction, drama, art and literary criticism, and satire. Diderot was also a brilliant conversationalist. He spent much of his life compiling, editing, and writing the French *Encyclopédie,* a reference work that reflected revolutionary political views and antireligious sentiment. Diderot's major philosophical works are *Thoughts on the Interpretation of Nature* (1754) and *d'Alembert's Dream* (1769). Today, Diderot is increasingly appreciated for his major literary writings, especially the novels *The Nun* (1760) and *Jacques the Fatalist* (1773) and the satirical dialogue *Rameau's Nephew* (written 1762-1764).

Diderot strongly supported experimental methods in philosophy and science. He believed that nature was in a state of constant change and no permanently adequate interpretation of it was possible. Diderot was also a philosophical materialist, believing that thought developed from the movements and changes of matter. His views on this subject were vague, as were his religious opinions. At one time, he was an atheist. At another time, Diderot was a deist, believing that God existed independently of the world and had no interest in it. But he later suggested that all of nature was God. Diderot was born in Langres, near Chaumont. James Creech

See also **Age of Reason; Encyclopedia** (An age of experiment); **Drama** (European drama [France]).

Didion, *DIH dih ahn,* **Joan** (1934-), is an American essayist and novelist. She was born in Sacramento, California, and often has used California's culture and geography and the lives of its residents as topics and symbols. Didion writes in a spare and intense style that conveys a lack of roots and a sense of social disintegration.

© Jill Krementz

Joan Didion

In the title essay of her collection *Slouching Towards Bethlehem* (1968), Didion examines the drug culture of the mid-1960's in the Haight-Ashbury section of San Francisco. Her collection *The White Album* (1979) similarly explores such California phenomena as exotic religious groups and Los Angeles freeways. The essays collected in *After Henry* (1992) also deal primarily with California subjects. Her nonfiction book *Miami* (1987) analyzes the impact of Cuban exiles on the city of Miami.

Didion's novels include *Run River* (1963), *Play It As It Lays* (1970), *A Book of Common Prayer* (1977), and *Democracy* (1984). Didion concentrated on political subjects in such nonfiction books as *Salvador* (1983), based on a trip that she took to El Salvador. Marcus Klein

Dido, *DY doh,* also called Elissa, *ih LIHS uh,* was the legendary founder and queen of Carthage. She was the daughter of King Belus of Tyre, and the wife of Sychaeus, or Acerbas. She fled to Africa with many devoted followers after her brother, Pygmalion, murdered her husband. There she was offered as much land as might be surrounded by a bull's hide. She cut a hide into thin strips, pieced them together, and laid them out to surround a large area. This area became the site of Carthage (see **Carthage**).

In the original legend, Dido committed suicide to escape an African prince who wished to marry her. But in the Roman epic poem the *Aeneid,* Dido killed herself after the Trojan hero Aeneas deserted her. Aeneas later saw Dido when he visited the underworld, but she had been happily reunited with Sychaeus and would not look at Aeneas (see **Aeneid**). Elaine Fantham

Didrikson, Babe. See **Zaharias, Babe Didrikson.**

Didymus. See **Thomas, Saint.**

Die and diemaking. A die is a precision tool used to shape or cut metals or other materials. Diemaking is the process of producing dies. Workers who make dies are usually called *tool-and-die makers.* They rank among the most highly skilled industrial workers. Tool-and-die makers create products ranging from small diamond dies, used to draw metal into fine wire, to huge metal dies that form automobile parts from sheet metal.

Materials used for making dies include alloy steels, rubber, plastics, and certain combinations of materials. The materials are shaped by basic machine tools or by newer methods, including the use of electricity (see **Machine tool** [Advanced machine tool operations]). After shaping, most dies are *heat treated* (carefully heated and cooled) to make them more resistant to wear.

When in use, certain dies must be lubricated. Common lubricants include oils and greases, soap solutions, and various chemical compounds. Dies used at high temperatures require such lubricants as graphite in oil or water, or molybdenum disulfide.

Dies are used in several industrial processes, including die casting, drawing, extrusion, forging, and stamping. Some of these processes use pairs of dies, one called a *male* die, or *punch,* and the other a *female* die.

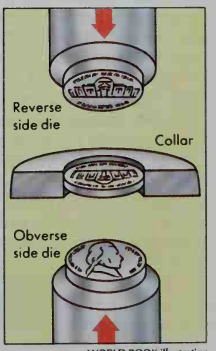
In die casting, metals are melted in a machine that forces the liquid metal into steel dies. These dies replace the molds used in other casting. The metal hardens into the design of the die and comes out solid. See **Cast and casting.**

In drawing and extrusion, a hot or cold solid material, usually metal, is forced through an opening in a die (see **Extrusion**).

In forging, metal is often heated and put into two dies. The dies are pressed together and shape the metal. See **Forging.**

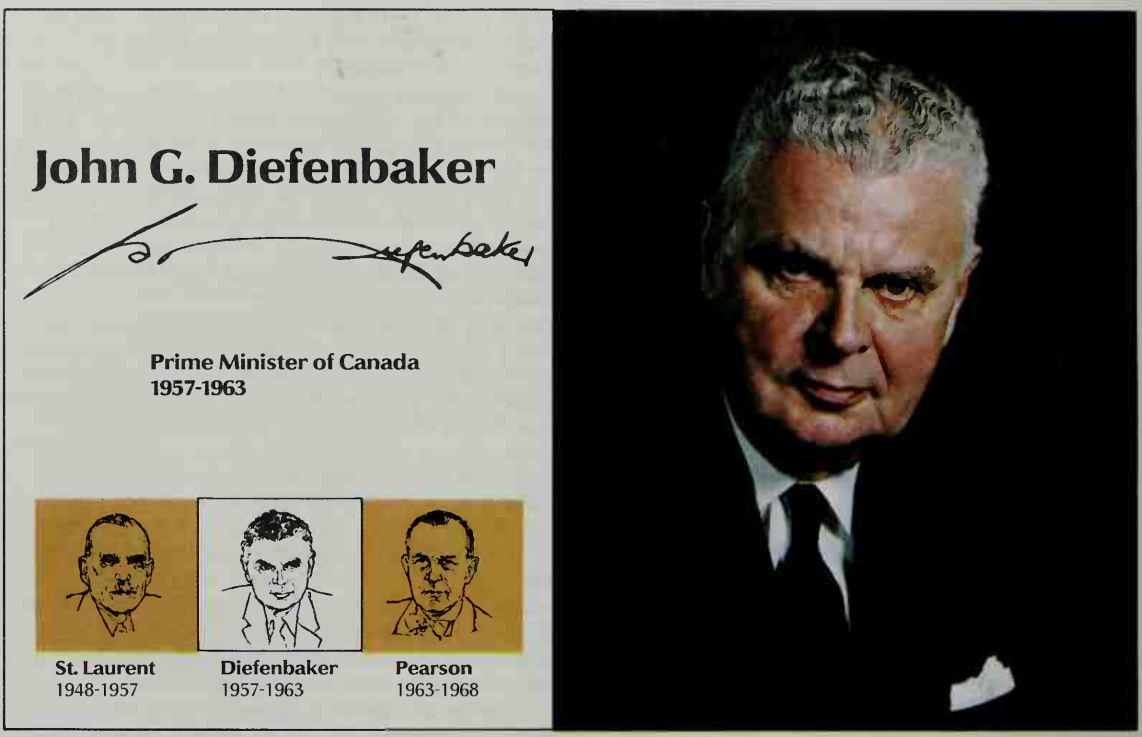
In stamping, a machine uses dies to stamp sheets, plates, or strips of metal or other materials, including plastics. Some stamping dies punch a hole in metal or cut it to a desired shape. Others form and shape the metal. Still others do both jobs. Melvin Bernstein

See also **Toolmaking.**



WORLD BOOK illustration by Sarah Woodward

Coin-stamping dies are used to stamp both sides of a coin in one operation. A collar holds the smooth disk of coin metal, called a *blank,* as it is fed into a stamping press.



John Evans

Diefenbaker, *DEE fuhn BAY kuhr,* **John George** (1895-1979), served as prime minister of Canada from 1957 to 1963. One of the reasons for the defeat of Diefenbaker's Progressive Conservative government was his refusal to accept atomic warheads for defense missiles supplied by the United States. The Liberals won the election of April 1963, and Liberal leader Lester B. Pearson became prime minister.

The Progressive Conservatives elected Diefenbaker as party leader in 1956. Diefenbaker led his party to victory in the 1957 election, and became the first Progressive Conservative prime minister in 22 years. In 1958, Canadians reelected the party with the largest parliamentary majority in the nation's history. The Progressive Conservatives won again in the 1962 election, but did not have an absolute majority in Parliament. Diefenbaker's government stayed in power only with the support of the small Social Credit Party.

As prime minister, Diefenbaker increased Canada's social welfare programs and speeded development of the nation's rich northland. Canada faced serious economic problems in the early 1960's, and Diefenbaker adopted austerity measures to fight them. Under Diefenbaker, Canada increased its trade with Communist countries. The St. Lawrence Seaway was completed, and Georges-Philias Vanier became the first French-Canadian governor general of Canada.

Tall and thin, with gray, curly hair and piercing blue eyes, Diefenbaker won friends and made enemies with his strong personality and fighting spirit. Diefenbaker made strong appeals to the national feeling of Canadians. "We are an independent country," he declared, "and we have the right to assert our rights and not have them determined by another country." Some people called Diefenbaker's attitude "anti-American," but he disagreed. "The very thought is repugnant to me," Diefenbaker said. "I am strongly pro-Canadian."

Early life

Boyhood and education. John Diefenbaker was born on Sept. 18, 1895, in the village of Neustadt, Ont. The family of his father, William, had come to Canada from Germany. His mother, Mary Florence Bannerman Diefenbaker, was a granddaughter of George Bannerman, one of Lord Selkirk's Scottish settlers in the Red River Colony of Manitoba. John had a younger brother, Elmer.

John's father taught school for 20 years, then became a civil servant. As prime minister, Diefenbaker recalled: "My father was a person who had a dedicated devotion to the public service. Throughout the schools he taught, there were a great many who went into public life, because of his feeling that it was one field in which there was a need."

In 1903, the family moved to a homestead in Saskatchewan. John loved stories of the early days on the prairie. He was fascinated by tales about Gabriel Dumont, Louis Riel's right-hand man during the North West Rebellion of 1885 (see **North West Rebellion**). John also studied the lives of such men as Abraham Lincoln, William Gladstone, and Napoleon.

John's interest later shifted to Canadian history. One night, according to a family legend, he looked up from reading a biography of Prime Minister Sir Wilfrid Laurier and announced: "I'm going to be premier (prime minister) of Canada." But John most admired former Prime Minister Sir John A. Macdonald.

In 1910, the Diefenbakers moved to Saskatoon, Sask.,

so John could attend high school there. John went on to the University of Saskatchewan, where he was active in campus politics. The college magazine predicted that someday he would lead the opposition in the House of Commons. He received his bachelor's degree in 1915 and a master's degree in 1916.

Diefenbaker was commissioned a lieutenant in the Canadian Army during World War I. He arrived in France in 1916, but was returned to Canada the next year after being injured in training camp.

Young lawyer. Diefenbaker had always planned to be a lawyer. "There was no member of my family who was a lawyer," he said, "but I never deviated from that course from the time I was 8 or 9 years of age." He studied law at the University of Saskatchewan and received his law degree in 1919. That same year, he opened a small office in the nearby town of Wakaw.

Diefenbaker developed an outstanding reputation as a defense lawyer. Some people who heard him in court claimed he could hold a jury spellbound with his oratory. "I just chat with the jury," said Diefenbaker.

In 1923, Diefenbaker moved to Prince Albert, Sask. He became a King's Counsel in 1929, and was a vice president of the Canadian Bar Association from 1939 to 1942.

Diefenbaker married Edna May Brower in 1929. She died in 1951. Two years later, he married Mrs. Olive Freeman Palmer, an old friend from Wakaw. Mrs. Palmer, a widow with a grown daughter, was assistant director of the Ontario Department of Education.

Member of Parliament

In 1925 and 1926, Diefenbaker ran as a Conservative Party (called Progressive Conservative Party after 1942) candidate for the Canadian House of Commons. He lost both times. He ran for the Saskatchewan legislature in 1929 and 1938, and was defeated each time. He also ran for mayor of Prince Albert in 1934, and lost.

Diefenbaker's repeated defeats did not discourage him. He became leader of the Saskatchewan Conservative Party in 1936 and served until 1940. That year, he won election to the House of Commons from Lake Centre. Diefenbaker was reelected to Parliament from Lake Centre in 1945 and 1949. He won election to the House of Commons from Prince Albert in 1953.

As a lawyer, Diefenbaker had made a reputation by defending individual civil rights. As a member of Parliament, he argued for a national bill of rights. Canada's first bill of rights was adopted in 1960 when Diefenbaker was prime minister.

The first bill Diefenbaker introduced in Parliament provided for Canadian citizenship for Canadians. They were then British subjects. Diefenbaker denounced what he called "hyphenated citizenship." He meant that every Canadian was listed in the census by the national origin of his father, such as French or Italian.

In 1948, the Progressive Conservatives met to choose a leader to succeed John Bracken. Some members suggested Diefenbaker, but the party chose George Drew. In 1956, Drew became ill and gave up politics. Diefenbaker was chosen leader in December 1956.

The Progressive Conservatives, discouraged after a long period of Liberal rule, held little hope for a victory in the 1957 election. But Diefenbaker waged a vigorous campaign. He charged that the Liberals had grown too powerful. Diefenbaker seemed to radiate vitality as

Important dates in Diefenbaker's life

1895 (Sept. 18) Born in Neustadt, Ont.
1929 Married Edna May Brower.
1936 Became leader of Saskatchewan Conservative Party.
1940 Elected to Parliament.
1951 Mrs. Edna Diefenbaker died.
1953 Married Mrs. Olive Freeman Palmer.
1956 Chosen leader of Progressive Conservative Party.
1957 (June 21) Became prime minister of Canada.
1958 Progressive Conservatives won largest parliamentary majority in Canadian history.
1962 Progressive Conservatives won reelection.
1963 Liberals defeated Progressive Conservatives. Diefenbaker resigned as prime minister on April 22.
1967 Succeeded as party leader by Robert L. Stanfield.
1979 (Aug. 16) Died in Rockcliffe Park, Ont.

WORLD BOOK illustration by Tom Doresett

Important events during Diefenbaker's Administration

AP/Wide World

St. Lawrence Seaway was opened in 1959. Taking part in the ceremony were, *second, third, and fourth from left,* Queen Elizabeth II, Diefenbaker, and U.S. President Dwight D. Eisenhower.

Hospitalization insurance for all Canadians was set up by the government in 1961.

Canadian dollar was devalued to 92.5 cents during an economic crisis in 1962.

Atomic weapons dispute with the United States led to the downfall of Diefenbaker's government in early 1963.

he told of his plans for developing northern Canada.

In the 1957 election, the Progressive Conservatives won more seats in Parliament than any other party, though they did not win a majority. Diefenbaker became the first Conservative prime minister since Richard B. Bennett, who served from 1930 to 1935.

Prime minister (1957-1963)

John G. Diefenbaker, the first prime minister of Canada to come from a prairie province, took office on June 21, 1957. He succeeded Louis S. St. Laurent.

Parliament passed several bills sponsored by Diefenbaker's government. One bill increased old-age pensions. Other legislation provided loans to economically depressed areas. Another bill gave financial aid to expand hydroelectric power in the Atlantic provinces.

In 1958, Diefenbaker asked for a new election. He wanted more supporters in Parliament to help him pass his legislative program. His party won 208 of the 265 seats in the House of Commons—the largest parliamentary majority in Canadian history.

Much of Diefenbaker's social legislation soon became law. Parliament increased pensions for the blind and disabled, and approved a program of federal hospital insurance. In 1958, the government began to build roads into Canada's rich but undeveloped northland.

Economic problems. During the early 1960's, Diefenbacker's government faced major economic problems. Canada imported far more from the United States than it sold there. In an effort to improve the trade balance, Diefenbacker urged Canadians to increase their trade with nations of the British Commonwealth. The government set up restrictions to discourage Canadians from investing abroad. It wanted such investments to take place in Canada, where it would aid the economy. But these measures did not solve the problem. Canada also faced major unemployment—up to 11 percent of the work force in 1961 and 1962.

By the middle of 1962, Diefenbaker was forced to adopt austerity measures to boost the ecomomy. The government lowered the value of the Canadian dollar. The government also reduced spending, raised tariffs on imports, and borrowed about $1 billion from foreign banks. In the election of June 1962, the Progressive Conservatives won the most seats in Parliament but did not win an absolute majority. Diefenbaker remained prime minister only because the Social Credit Party supported him.

Nuclear controversy. In 1961, it was announced that the United States would supply Canada with missiles that were essential for the defense of North America. But the Canadian government was not ready to accept atomic warheads for these missiles. By 1963, Canada had still not equipped the missiles with atomic warheads.

On Jan. 30, 1963, the United States charged that Canada had failed to propose a practical plan for arming its forces against a possible Soviet attack. Diefenbaker angrily answered that the U.S. statement was "an unwarranted intrusion in Canadian affairs." He opposed acquiring nuclear warheads, saying that United States control of the missiles would threaten Canadian sovereignty. However, Liberal leader Lester B. Pearson declared Canada should live up to its agreement with the United States and accept nuclear warheads. On February 5, the House of Commons passed a motion of no-confidence in Diefenbaker's government, and the government fell from power.

In the election of April 1963, the Liberals won 129 seats in the House of Commons. This was just short of an absolute majority of the 265 seats, but more than any other party won. The Progressive Conservatives won only 95 seats. Pearson succeeded Diefenbaker as prime minister on April 22, 1963.

Later years

Diefenbaker led the opposition in Parliament until 1967, when the Progressive Conservatives chose Robert L. Stanfield to succeed him. Diefenbaker continued to represent Prince Albert in the Canadian House of Commons. He served as chancellor of the University of Saskatchewan from 1969 until his death.

Diefenbaker died of a heart attack at his home in the Ottawa suburb of Rockcliffe Park on Aug. 16, 1979. He was buried in Saskatoon, Saskatchewan. G. F. G. Stanley

See also **Canada, History of; Pearson, Lester B.; Prime minister of Canada.**

Additional resources

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Diego Garcia, *dee AY goh gahr SEE uh,* is an island in the Indian Ocean. It is part of the Chagos Archipelago, an island group. The United States maintains a naval facility on the island that serves as a communications center and a refueling stop for ships and airplanes.

Diego Garcia is a U-shaped coral island called an *atoll.* It is about 15 miles (24 kilometers) long, and about 7 miles (11 kilometers) wide at its widest point.

Diego Garcia came under Britain's control in 1814, and until 1965 was administered as a dependency of the British colony of Mauritius. In 1965, Diego Garcia became part of a newly formed British dependency called the British Indian Ocean Territory. For the location of this territory, see **World** (political map).

The U.S. naval facility on Diego Garcia was built during the 1970's. By 1973, British authorities had moved all of the island's inhabitants to Mauritius.

Since 1982, Mauritius has claimed the Chagos Archipelago, including Diego Garcia. In 1991, during the Persian Gulf War, the United States used Diego Garcia as a base for airplanes that attacked Iraqi targets.

Robert LaPorte, Jr.

Diem, Ngo Dinh. See Ngo Dinh Diem.

Diemaking. See Die and diemaking.

Dien Bien Phu, *dyehn byehn FOO,* **Battle of,** was fought between Vietnamese Communists, called *Vietminh,* and France in 1954. It was the decisive battle of the Indochina War (1946–1954). The French were defeated, and they gave up their colonies in Indochina.

In November 1953, France began building an army base around the village of Dien Bien Phu (also called Dien Bien), in what is now northwestern Vietnam. For the village's location, see **Vietnam** (map). The base was intended to disrupt Vietminh army movements. On March 13, 1954, about 50,000 Vietminh soldiers began

attacking the French force of more than 10,000 troops at the base. They quickly destroyed the base's airfield, leaving the French without adequate supplies. The outnumbered French resisted the Vietminh attack for 56 days, but were forced to surrender on May 7, 1954. The fighting ended early the next day. David P. Chandler

Diesel, *DEE zuhl,* **Rudolf** (1858-1913), a German mechanical engineer, developed the first internal-combustion engine in which the fuel was ignited without a spark. In this type of machine, now known as the *diesel engine,* heat inside the cylinders ignites the fuel. Today, diesel engines power locomotives, large trucks, ships, and some automobiles. See **Diesel engine.**

Diesel was born in Paris of German parents. He studied in Munich under German chemist Carl von Linde, who invented the refrigeration system used in most electric refrigerators in today's homes. Diesel patented his engine design in 1892 and operated the first successful model in 1897. Later, he founded a factory to make his engines. He eventually sold it because of financial problems. In 1913, he mysteriously disappeared from a German ship bound for London. David F. Channell

See also **Ship** (Increasing power and speed).

Diesel engine, *DEE zuhl* or *DEE suhl,* is a type of internal-combustion engine used chiefly for heavy-duty work. Most of the locomotives in the United States are diesel powered. Diesel engines drive huge freight trucks, large buses, tractors, and heavy roadbuilding equipment. They are also used to power submarines and ships, the generators of electric-power stations in small cities, and emergency electric-power generators. Some automobiles are powered by diesel engines.

How a diesel engine works. There are two main types of internal-combustion engines—gasoline engines and diesel engines. The gasoline engine, found in most cars, is a *spark-ignition* engine. It uses electricity and spark plugs to ignite the fuel and air mixture in the engine's cylinders (see **Gasoline engine**). The diesel engine is a *compression-ignition* engine. It compresses the air in the cylinders, causing the temperature of the air to rise. Fuel injected into the hot, compressed air immediately ignites.

During the combustion process, the stored chemical energy in the fuel is converted to *thermal,* or heat, energy. The temperature in each cylinder rises as high as 4500 °F (2480 °C) and creates pressures of 1,500 pounds per square inch. The pressure pushes against the tops of the pistons, forcing them to the other end of their cylinders. The pistons are connected by a rod or other mechanism to a crankshaft that they turn. In this way, a diesel engine supplies rotary power to drive vehicles and other machines.

To ignite the fuel, the compressed air must have a certain temperature. The degree to which the temperature of the air rises depends on the amount of work done by the piston in compressing it. This work is measured as a ratio between the volume of uncompressed air and the volume of the air after compression. The compression ratio necessary to ignite the fuel depends on the size of the engine's cylinders. In large cylinders, the compression ratio is about 13 to 1. For small cylinders, it may be as high as 22 to 1.

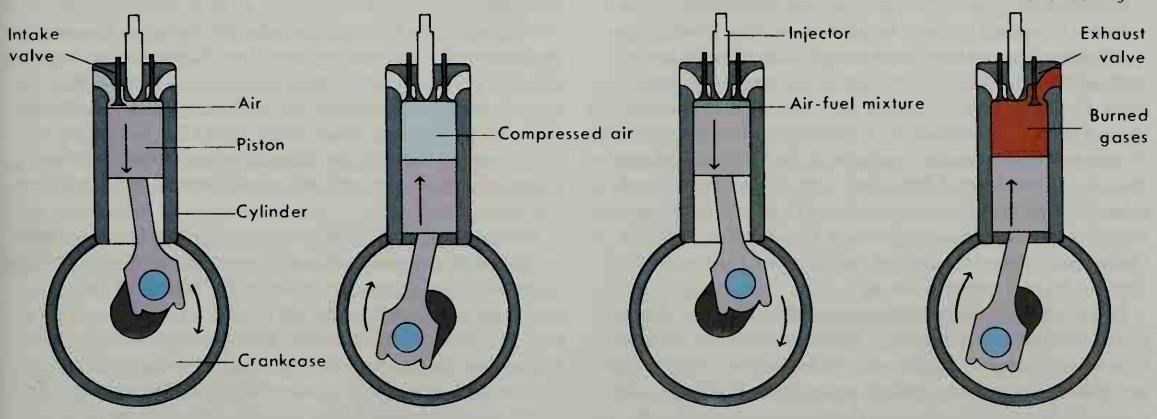
Near the end of the piston's compression stroke, the fuel is injected into the cylinder. In order for the fuel and air to mix well, the fuel is injected under high pressure as a spray. Combustion usually starts just before the piston ends its compression stroke. The power of diesel engines can be increased by *supercharging,* or forcing air under pressure into the cylinder. See **Fuel injection.**

Diesel engines have a high *thermal efficiency,* or ability to convert the stored chemical energy in the fuel into *mechanical energy,* or work. In the spark-ignition engine, the amount of power produced is determined by a throttle that regulates how much air and fuel enter the cylinder. The throttle may operate in a partly closed position much of the time, thereby reducing the engine's air intake and efficiency. Diesel engines do not require a throttle, making them more efficient than gasoline engines.

How a four-cycle diesel engine works

A cycle begins with the intake stroke when the piston moves down and draws air into the cylinder. The piston rises and compresses the air. During the compression stroke, the air temperature rises to about 900 °F (480 °C). When fuel is injected into the cylinder, it mixes with the hot air and burns explosively. Gases produced by this combustion push the piston down for the power stroke. During the exhaust stroke, the piston moves up and forces the burned gases out of the cylinder.

WORLD BOOK diagram



Diesel engines are suited for heavy-duty work because they are larger and heavier than gasoline engines of equal power and therefore can better withstand heavy loads. In addition, diesel engines burn fuel oils, which require less refining and are cheaper than higher-grade fuels such as gasolines.

Kinds of diesel engines. There are two main types of diesel engines. They differ according to the number of piston strokes required to complete a cycle of air compression, power, exhaust, and intake of fresh air. A *stroke* is an up or down movement of a piston. These engines are (1) the four-stroke cycle engine and (2) the two-stroke cycle engine.

In a four-stroke cycle engine, each piston moves down, up, down, and up to complete a cycle. The first downstroke draws air into the cylinder. The first upstroke compresses the air. The second downstroke is the power stroke. The second upstroke exhausts the gases produced by combustion. A four-stroke engine requires exhaust and air-intake valves.

In a two-stroke cycle engine, the intake and exhaust processes occur near the end of the piston downstroke, or power stroke. The two-stroke cycle engine does not need valves. As the piston rises during the upstroke, it compresses the air and closes the intake and exhaust ports. The fuel is injected near the end of this compression stroke. Because the two-stroke cycle engine has twice as many power strokes as the four-stroke cycle engine, it provides more power.

History. The diesel engine is named for Rudolf Diesel, the German engineer who invented it. Diesel patented his design for the engine in 1892 and built his first engine in 1893. The engine exploded and almost killed him, but it proved that fuel could be ignited without a spark. He operated his first successful engine in 1897. Later, Sir Dugald Clerk of Britain developed the two-stroke diesel. William H. Haverdink

See also **Diesel, Rudolf; Locomotive; Starter.**

Diet is the food and drink that a person takes regularly day after day. The word *diet* also refers to the amounts or kinds of food needed under special circumstances, such as losing or gaining weight. Diet needs vary according to age, weight, health, climate, and amount of activity. *Dietetics* is the science of feeding individuals or groups. The money that is available and health and nutritional needs affect the type of feeding prescribed.

Normal diet, or *balanced diet,* contains all the food elements needed to keep healthy. A person needs *minerals, proteins, vitamins,* and certain *fats* to build and maintain tissues and to regulate body functions. Proteins, fats, and *carbohydrates* are used to provide energy and heat. Food elements often eaten in smaller than recommended amounts include calcium, iron, and vitamins A, C, and D, and *folic acid* (a B vitamin also called folate). A diet that lacks any needed food element may cause certain *deficiency diseases.* For example, lack of vitamin C causes scurvy, and lack of iron, folic acid, or vitamin B_{12} may cause anemia.

Diets for losing or gaining weight. Both the energy value of food and the energy spent in daily activity are measured in units of heat called *kilocalories.* These units are usually referred to simply as *calories.* Diets for gaining or losing weight are based on the amount of calories taken into the body in food and the amount of calories used up in activity. If people take in more calories than they use up, they will gain weight. They will lose weight if they take in fewer calories than they use up. A diet aimed toward losing or gaining weight should include all necessary food elements. People should seek the advice of a doctor before beginning such a diet.

Special diets may be prescribed for people with certain conditions. For example, a person with diabetes must limit use of sugar. Doctors may prescribe low-salt diets for patients with certain heart or kidney diseases.

Some people have allergic reactions to certain foods, such as milk, strawberries, wheat, eggs, or nuts. These people should avoid such foods and consult a physician.

Mary Frances Picciano

Related articles in *World Book* include:

Allergy	Dietary supplement	Health	Protein
Baby (Feeding procedures)	Digestive system	Lipid	Vitamin
Calorie	Fat	Metabolism	Weight control
Carbohydrate	Food	Nutrition	
Cooking		Overeaters Anonymous	

Dietary fiber. See Fiber, Dietary.

Dietary supplement is any product taken in addition to a normal balanced diet that is not a food or a drug. Dietary supplements include vitamins, minerals, amino acids, herbal preparations, and other substances derived from plants. Millions of people take dietary supplements to help ensure adequate nutrition, increase energy, reduce stress, or relieve some condition. They often regard the supplements as "natural" substitutes for drugs. Dietary supplements are sold as pills, capsules, liquids, extracts, teas, and powders. Many supplements are based on traditional folk or herbal remedies.

Many kinds of supplements, such as vitamins, provide substances that are necessary to maintain good health. Most people, however, get enough of these substances in a balanced diet. Other dietary supplements contain naturally occurring compounds that can act like drugs. In the United States, drugs must be approved by the Food and Drug Administration (FDA) before they can be sold. The FDA ensures that drugs are safe and are effective to treat the conditions for which they are prescribed. Dietary supplements can be sold without FDA approval, and thus may not be safe or effective.

Most dietary supplements are safe when taken according to directions, but some can be dangerous. Ephedra, also called *ma huang,* an herb taken to help people increase energy, contains the natural chemical *ephedrine.* Ephedrine is a stimulant that is also an ingredient in several drugs. There are concerns that it may cause serious side effects, including irregular heartbeat, seizures, stroke, and even death. The FDA has taken steps toward limiting the amount of ephedra in dietary supplements, and some states have banned all products containing the herb.

Dietary supplements can also cause harmful reactions by interacting chemically with prescription drugs. Responsible manufacturers have added labels to their products warning people not to take a supplement if they are taking certain medications. People should consult a physician before taking any dietary supplement.

Scientists are studying many kinds of dietary supplements to determine if they are effective in treating diseases. One supplement under study is made from the

leaves of the ginkgo tree, which have been used as medicine for hundreds of years in China. Researchers have found that ginkgo extract may help improve short-term memory and concentration in people with Alzheimer's disease. The FDA, however, forbids manufacturers from claiming that any dietary supplement can treat, cure, or prevent disease. Melanie Johns Cupp

See also **Drug; Food additive; Vitamin.**

Diethylstilbestrol. See DES.

Dietrich, *DEE trihk,* **Marlene,** *mahr LAY nuh* (1901?-1992), a German-born actress and singer, became a famous movie star. Her sex appeal, shapely legs, and husky voice made her an international favorite for over 40 years.

United Press Int.

Marlene Dietrich

Dietrich first gained attention for her performance in the German film *The Blue Angel* (1930), directed by Josef Von Sternberg (see **Von Sternberg, Josef**). He guided her career and brought her to the United States, where they made *Morocco* (1930), *Dishonored* (1931), *Shanghai Express* (1932), *Blonde Venus* (1932), *The Scarlet Empress* (1934), and *The Devil Is a Woman* (1935). Her other Hollywood films include *Destry Rides Again* (1939), *A Foreign Affair* (1948), and *Witness for the Prosecution* (1957). Dietrich was born in Berlin. Her full name was Maria Magdalene Dietrich. Louis Giannetti

Dietrich of Bern. See Theodoric.

Diffraction is the spreading out of waves—water, sound, light, or any other kind—as they pass by the edge of an obstacle or through an opening. Diffraction explains why water waves spread out in all directions after passing through a narrow channel in a breakwater. It also explains why sound can be heard around a corner even though no straight path exists from the source to the ear.

Diffraction of light differs from diffraction of sound because diffraction is most evident when the obstacle is about the same size as the wavelength diffracted. The sound waves we hear have wavelengths of about a yard and are diffracted by ordinary objects. But visible light waves have wavelengths of less than $\frac{1}{35{,}000}$ of an inch (0.00007 centimeter). Thus, light waves can be diffracted noticeably only by extremely small objects.

How diffraction occurs. Diffraction takes place among all waves at all times. To understand why it becomes noticeable only when the obstacle is about the size of the diffracted wavelength, one must understand both diffraction and *interference.*

Christiaan Huygens, a Dutch scientist, developed the principle that explains why diffraction occurs. This principle states that each point on the surface of a wave is the source of small waves. These wavelets move outward in all directions. To find the total wave reaching an area, all the wavelets that strike the area must be considered. If the crests of two wavelets reach a point at the same time, they reinforce each other. This condition is called *constructive interference,* and the resulting wave is large. If the crest of one wave reaches a point at the same time as the low point of another, the two waves cancel each other. This condition is called *destructive interference,* and the resulting wave is small or nonexistent. See **Interference.**

A beam of light moves in a straight line because effects of diffraction outside the beam are canceled by destructive interference. The wavelets at the edge of the beam spread, but most of the light travels in a straight line with the beam. When light travels through a tiny opening, interference occurs only among the wavelets coming from the opening. These wavelets produce a diffraction pattern because most of the destructive interference has been eliminated.

Diffraction of light from a tiny source can likewise be observed if some of the light—and thus its interference—is removed. A disk placed in the path of such a source blocks out the wavelets that originate behind the disk. At points beyond the disk, these eliminated wavelets are missing not only in the shadow of the disk but also outside of the shadow, where they would have interfered constructively. The shadow pattern on a screen beyond the disk consists of a series of rings, alternately light and dark, in and surrounding the shadow area. A bright spot occurs at the center of the shadow because at that point all waves interfere constructively. They do so because they have all traveled the same distance from the edge of the disk.

Uses of diffraction. The occurrence of diffraction has been used as a test of whether various things are waves. For example, diffraction of X rays by crystals convinced scientists that X rays are waves.

The pattern of X-ray diffraction depends on the type and distribution of atoms in the diffracting substance. This fact has been used to study the structure of crystals by X-ray diffraction and to discover the structure of proteins and nucleic acids.

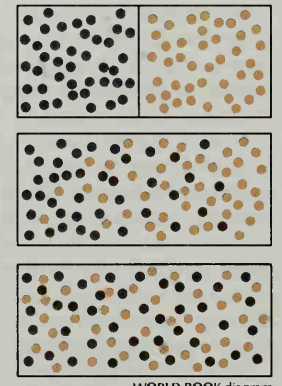
A *diffraction grating* is a glass plate with lines ruled on it at small, equal intervals. Light can pass only between the lines, and the slits are about as far apart as a wavelength of light. If a parallel beam of white light strikes the grating, a pattern of light of various colors appears on a screen beyond the grating. The colors appear because white light consists of different colors. These colors have different wavelengths, and the longer wavelengths are diffracted at greater angles. Scientists can identify a substance by the pattern of colors it produces through a diffraction grating. Gerald Feinberg

See also **Light** (How light behaves); **Molecule** (Studying molecules; picture); **Sound** (Diffraction); **Spectrometer; Waves.**

Diffusion, *dih FYOO zhuhn,* in chemistry, is the mixing of the atoms or molecules of one substance with those of another. It is caused by the natural movements of atoms and molecules. It differs from the mixing caused by stirring or shaking or the blowing of wind.

Diffusion occurs readily in gases and liquids because of the constant and random motion of their atoms and molecules. The process takes place more rapidly in gases than in liquids. Molecules of gases are farther apart and collide less frequently than those of liquids—and collisions among molecules hinder diffusion. In solids, the molecules are arranged in rigid patterns and move very little. Therefore, diffusion does not occur in solids

How diffusion occurs



These diagrams show how diffusion occurs in gases. The molecules of two different gases in a container are separated by a divider, *top*. After the divider is removed, the molecules begin to mix together because of their constant movement, *middle*. As the molecules move at random, some of them bump into one another and slow the mixing process. After sufficient time has passed, the molecules will be completely mixed, *bottom*.

WORLD BOOK diagram

except under special conditions.

Diffusion can be demonstrated by adding ink to a glass of water. Each molecule of ink has its own constant and random motion. The motion of the ink molecules causes them to spread through the water. The water molecules also move about and become mixed with the ink molecules. After being mixed completely, the molecules of ink and water each continue to move individually. But as a result of diffusion, the color of the mixture becomes the color of the ink.

Many common occurrences involve diffusion. For example, water boiling in an uncovered pot produces steam that disappears. The disappearance results from the diffusion of steam molecules with air molecules. Odors from flowers, food, perfume, and other sources are produced by the diffusion of special gaseous odor molecules with molecules of air. John B. Butt

Digestion. See Digestive system.

Digestive system is the group of organs that break down food into smaller particles, or molecules, for use in the human body. This breakdown makes it possible for the smaller digested particles to pass through the intestinal wall into the bloodstream. The particles are then distributed to nourish all parts of the body.

The digestive system consists primarily of the *alimentary canal*, a tube that extends from the mouth to the rectum. As food moves through this canal, it is ground and mixed with various digestive juices. Most of these juices contain *digestive enzymes*, chemicals that speed up reactions involved in the breakdown of food. The stomach and the small intestines, which are parts of the alimentary canal, each produce a digestive juice. Other digestive juices empty into the alimentary canal from the salivary glands, gallbladder, and pancreas. These organs are also part of the digestive system.

The fats, proteins, and carbohydrates (starches and sugars) in foods are made up of very complex molecules and must be digested, or broken down. When digestion is completed, starches and complex sugars are broken down into simple sugars, fats are digested to fatty acids and glycerol, and proteins are digested to amino acids and peptides. Simple sugars, fatty acids and glycerol, and amino acids and peptides are the digested foods that can be absorbed into the bloodstream. Such foods as vitamins, minerals, and water do not need digestion.

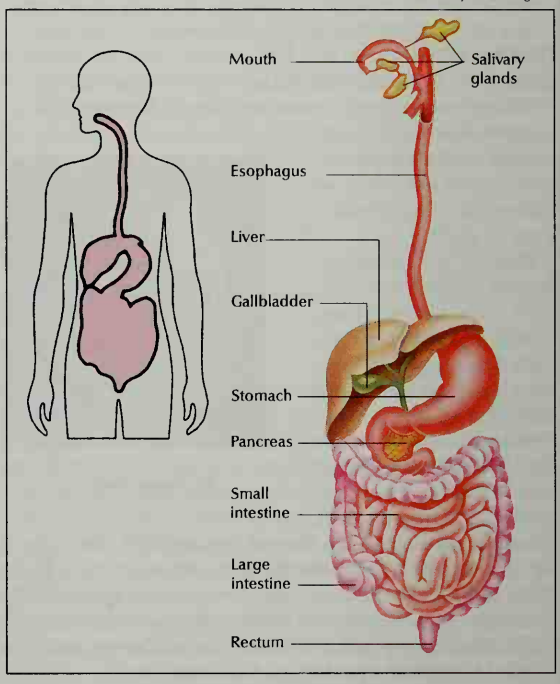
From mouth to stomach. Digestion begins in the mouth. Chewing is very important to good digestion for

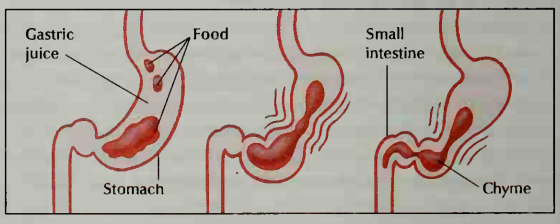
Digestion

Digestion is the process that breaks food down into simple substances the body can use. The digestive system includes all the organs and tissues involved in this process.

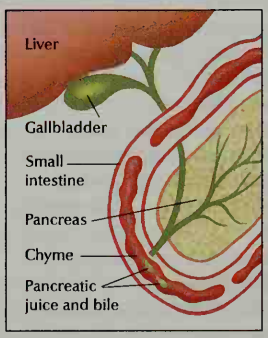
Parts of the digestive system

WORLD BOOK illustrations by Colin Bidgood

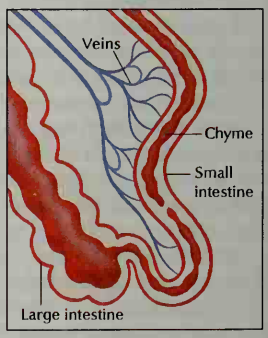




The stomach churns food and adds gastric juice, which breaks down proteins. Partially digested food exits the stomach as *chyme*.



Bile and pancreatic juice act on the chyme in the upper small intestine. Pancreatic juice digests proteins, fats, and sugars and starches. Bile helps break down fats.



Digested foods are absorbed into the bloodstream from the small intestine. The indigestible remains pass into the large intestine and are eliminated from the body.

two reasons. When chewed food is ground into fine particles, the digestive juices can react more easily. As the food is chewed, it is moistened and mixed with saliva, which contains the enzyme *ptyalin.* Ptyalin changes some of the starches in the food to sugar.

After the food is swallowed, it passes through the esophagus into the stomach. In the stomach it is thoroughly mixed with a digestive juice by a vigorous, to-and-fro churning motion. This motion is caused by contractions of strong muscles in the stomach walls.

The digestive juice in the stomach is called *gastric juice.* It contains, in most people, hydrochloric acid and the enzyme *pepsin.* This juice begins the digestion of protein foods such as meat, eggs, and milk. Starches, sugars, and fats are not digested by the gastric juice. After a meal, some food remains in the stomach for two to five hours. But liquids and small particles begin to empty almost immediately. Food that has been churned and partly digested is called *chyme.* Chyme passes from the stomach into the small intestine as a thick liquid.

In the small intestine, the digestive process is completed on the partly digested food by pancreatic juice, intestinal juice, and bile. The pancreatic juice is produced by the pancreas and pours into the small intestine through a tube, or duct. The pancreatic juice contains the enzymes *trypsin, amylase,* and *lipase.* Trypsin breaks down the partly digested proteins, amylase changes starch into simple sugars, and lipase splits fats into fatty acids and glycerol. The intestinal juice is produced by the walls of the small intestine. It has milder digestive effects than the pancreatic juice, but carries out similar digestion. Bile is produced in the liver, stored in the gallbladder, and flows into the small intestine through the bile duct. Bile does not contain enzymes, but it does contain chemicals that help break down and absorb fats.

When the food is completely digested, it is absorbed by tiny blood and lymph vessels in the walls of the small intestine. It is then carried into the circulation for nourishment of the body. Food particles are small enough to pass through the walls of the intestine and blood vessels only when they are completely digested.

Almost no digestion occurs in the large intestine. The large intestine stores waste food products and absorbs water and small amounts of minerals. The waste materials that accumulate in the large intestine are roughage that cannot be digested in the body. Bacterial action produces the final waste product, the *feces,* which are eliminated from the body. André Dubois

Related articles in *World Book* include:

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Beaumont, William	Dyspepsia	Liver	Sugar
Bile	Enzyme	Lymphatic system	Teeth
	Esophagus	Mastication	Triglyceride
	Fat		

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King, John E. *Mayo Clinic on Digestive Health.* Mayo Found., 2000.

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Digit. See Arabic numerals; Decimal system.

Digital computer. See Computer.

Digital technology includes all types of electronic equipment and applications that use information in the form of numeric code. This information is usually in *binary code*—that is, code that can be represented by strings of only two numeric characters. These characters are usually 0 and 1. Devices that process and use digital information include personal computers, calculators, automobiles, traffic light controllers, compact disc players, cellular telephones, communications satellites, and high-definition television sets.

Most of the information people sense is *analog* in nature—that is, it varies constantly, and an infinite number of values can be assigned to the information. For example, the brightness of a light bulb dimmed gradually from on to off could be considered analog information. This infinite number of brightnesses can be *quantized* (broken up into ranges). If the possible brightnesses are broken into two ranges, then the values 0 and 1 can hold digital information relating to the brightness of the bulb. However, each of the two digits still represents a countless number of analog values. The ranges of brightnesses can be divided again and again, until there are thousands of ranges of values, each of which can be represented by a numerical value.

Once analog information has been quantized into digital information, it is impossible to perfectly reverse the process and re-create all of the possible analog signals from the corresponding digital signals. This is why most analog signals are represented by a great number of digital information levels. For example, the sound stored as digital information on a compact disc (CD) is broken down into 65,536 levels. A CD player translates the digital information into analog information so that a speaker can convert it into sound waves.

Some devices process digital information using a tiny computer called a *microprocessor.* It performs calculations on digital information and then makes decisions based on the results. In such devices, computer chips called *memory chips* store digital information while it is not being processed. Software, which consists of instructions in the form of digital information, is used to control the sequence of operations in many devices that use digital technology. Don M. Gruenbacher

See also Compact disc; Computer (Microprocessors).

Digitalis, *DIHJ uh TAL ihs,* is the dried leaves of the purple foxglove, a garden flower. The word *digitalis* comes from *Digitalis purpurea,* the scientific name for this flower. In the past, doctors used digitalis to treat patients with heart failure or irregularly beating hearts.

The British physician William Withering is credited with first documenting the medicinal value of the purple foxglove in 1785. Scientists later determined that the leaves of the purple foxglove contain chemical compounds called *glycosides.* One of these glycosides, called *digitoxin,* was found to be particularly powerful in treating certain heart problems. Researchers also discovered that the leaves of the yellow foxglove *(Digitalis lanata)* contain *digoxin,* a glycoside even more useful in the treatment of such heart problems.

Today, chemists make pure preparations of either

digoxin or digitoxin. Doctors use these drugs in treating congestive heart failure to strengthen contractions of the weakened heart. These drugs also slow the heartbeat, making them useful in treating *atrial fibrillation* (a type of irregular, abnormally rapid heartbeat). Both drugs can be taken in tablet form. Digoxin can also be put in a liquid solution, which is injected into a vein or taken orally. Digitalis drugs can be toxic and should be taken only as directed by a doctor. N. E. Sladek

Dik-dik is one of the smallest antelopes. Dik-diks live in dense wooded areas. Four species live in eastern Africa and one in southwestern Africa. The tallest dik-diks are about 15 inches (40 centimeters) high at the shoulder. Females are larger than males but have no horns.

Dik-diks are delicate, slender animals with tiny hoofs, short tails, and long hairy muzzles. They live alone or in groups of two or three. Dik-diks warn each other of danger with high-pitched whistles. Anne Innis Dagg

Scientific classification. Dik-diks belong to the bovid family, Bovidae. They are genus *Madoqua.*

See also **Antelope** (with picture).

Dike. See **Irrigation** (Surface irrigation; picture: Flood irrigation); **Levee; Netherlands** (introduction).

Dill is a plant used to increase the flavor of pickles and other foods, including fish, sour cream, and vinegar. Dill is often grown for its seeds, which have a strong, bitter taste. Its small green leaves are called *dill weed.* A flavoring oil is also distilled from the plant. Albert Liptay

Scientific classification. Dill is in the parsley family, Apiaceae or Umbelliferae. It is *Anethum graveolens.*

Dillinger, John Herbert (1903-1934), was one of the most notorious criminals in United States history. In 1933 and 1934, he and his gangs attracted national headlines for a series of Midwestern bank robberies and narrow escapes from the law.

Dillinger was born on June 22, 1903, in Indianapolis, Indiana, and raised in nearby Mooresville. His first robbery took place in Mooresville in 1924. He was caught and jailed until 1933. Afterward, he helped some prisoners escape and joined them in forming a robbery gang.

In January 1934, Dillinger was arrested in Arizona and sent to Indiana to face charges of killing a policeman. He soon broke out of a supposedly escape-proof jail in Crown Point, Indiana, by using what he claimed was a carved wooden pistol. His flight across state lines in a stolen car violated federal law, making him a fugitive from the FBI, then called the Bureau of Investigation. After recruiting a gang, Dillinger resumed robbing banks. He escaped from gun battles with federal agents in Minnesota and Wisconsin. By mid-1934, he had been involved in at least 10 bank robberies in Indiana, Ohio, Wisconsin, and South Dakota.

Dillinger was hiding in Chicago when he was betrayed by Anna Sage, an acquaintance, on July 22, 1934. Sage told federal agents she would be wearing a red dress when she and a girlfriend accompanied Dillinger to the Biograph theater that night to see the Clark Gable crime movie *Manhattan Melodrama.* Federal agents fatally shot Dillinger as he left the theater, and Sage became famous as the "woman in red." William J. Helmer

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Toland, John. *The Dillinger Days.* 1963. Reprint. Da Capo, 1995.

DiMaggio, *duh MAH jee OH,* **Joe** (1914-1999), was one of the greatest outfielders in baseball history. He played his entire career, from 1936 through 1951, with the New York Yankees. DiMaggio was nicknamed "the Yankee Clipper" because of his graceful fielding and "Joltin' Joe" because of his powerful hitting. DiMaggio hit safely in 56 straight games in 1941, a major league record. He had a lifetime batting average of .325 and hit 361 home runs in 1,736 games. DiMaggio played in 10 World Series. He was voted the American League's Most Valuable Player in 1939, 1941, and 1947. In 1948, he led the league with 39 home runs and 155 runs batted in.

Joseph Paul DiMaggio was born on Nov. 14, 1914, in Martinez, California. Two of his brothers, Dominic and Vincent, also played major league baseball. DiMaggio was briefly married to movie star Marilyn Monroe in 1954. He was elected to the Baseball Hall of Fame in 1955. Dave Nightingale

See also **Baseball** (picture).

Dime is a United States coin worth 10 cents, or one-tenth of a dollar. The word dime comes from the Latin *decimus* (tenth). Until 1933, the dime was only legal as payment in amounts of $10 or less. Then, Congress made the dime legal tender in any amount. Dimes were made almost completely of silver until 1965. That year, Congress ruled that dimes should be made of a solid copper center between two layers of a copper-nickel alloy. See also **Fasces; Money** (picture: United States coins). R. G. Doty

Dimethyl sulfoxide. See DMSO.

Dimetrodon, *DY meht ruh don,* was an early prehistoric animal from what is now North America. It lived before the dinosaurs, about 290 million to 260 million years ago, during the Permian Period. The animal belongs to a group called *pelycosaurs,* the ancestors of modern mammals.

Dimetrodon grew about 11 $\frac{1}{2}$ feet (3.5 meters) long. It walked on four legs, which sprawled out to its sides. The animal possessed a tall, saillike fin on its back. This fin measured 2 to 3 feet (60 to 90 centimeters) high and was supported by bony spines and covered with scaly skin. Scientists believe the creature used its sail to control body temperature and to signal other *Dimetrodons.*

Dimetrodon's name means *two sizes of teeth.* Its powerful jaws had long, sharp teeth in front, probably for killing prey. Smaller, shorter teeth for chewing food grew on the sides of the jaws. *Dimetrodon* ranked as one of the largest meat-eaters of its time. Its diet probably included other pelycosaurs.

American scientist Edward Drinker Cope named *Dimetrodon* in the 1880's. Its remains have been found in the southwestern United States. David B. Weishampel

See also **Evolution** (picture: Evolution of mammals from reptiles); **Prehistoric animal** (picture: Animals of the Paleozoic Era).

Dine, Jim (1935-), is an American artist. He became associated with the pop art movement, which developed during the 1960's.

Dine's works include images of familiar, everyday objects, such as tools, a bathrobe, and neckties, as well as brushes and color charts used by professional house painters. By representing these objects in isolation from their normal surroundings, Dine gives them a height-

ened, almost religious, significance. Dine works with a variety of materials. He has created paintings, sculptures, drawings, and prints. He has incorporated real objects into some of his paintings. Dine often uses few, and fairly drab, colors, though he has occasionally added bright colors to highlight and emphasize his forms.

Beginning in the mid-1970's, Dine created works with references to earlier art, particularly Greek sculpture. His later works are also more expressionistic and symbolic, though he continues to use recognizable imagery. James Dine was born on June 16, 1935, in Cincinnati, Ohio. Deborah Leveton

Dinesen, *DEE nuh suhn,* **Isak,** *EE sak* (1885-1962), was the pen name of Baroness Karen Blixen-Finecke, a Danish author who wrote in English and Danish. Like Gothic fiction, her stories deal with fantastic, unreal, often grotesque people and situations. She had a deep concern for the supernatural, and she preferred to portray life in exotic settings of the past. Her volumes of short stories include *Seven Gothic Tales* (1934), *Winter's Tales* (1942), *Last Tales* (1957), and *Anecdotes of Destiny* (1958).

Karen Christence Dinesen was born on April 17, 1885, in Rungsted, Denmark. She was married to Baron Bror Blixen-Finecke in 1914 and divorced in 1921. She owned a coffee plantation in eastern Africa and lived there from 1914 to 1931. Then she returned to Denmark. She recorded her years in Africa in two books of memoirs, *Out of Africa* (1937) and *Shadows on the Grass* (1961). Niels Ingwersen

Dingo, *DIHNG goh,* is a wild dog of Australia. It ranks as the largest hunting mammal on that continent. The Aborigines, Australia's first human inhabitants, brought dingoes to the continent thousands of years ago. Dingoes closely resemble certain medium-sized domestic dogs, but they also share characteristics with wolves. For example, they howl like wolves and rarely bark.

Dingoes grow about 24 inches (60 centimeters) tall at the shoulder and weigh from 20 to 45 pounds (9 to 20 kilograms). The dogs usually have a golden-colored coat with white fur on the feet and the tip of the tail. But a dingo's color can range from yellowish-white to black.

Each year, female dingoes give birth in a cave or hollow log to four or five young. The pups may live with their parents and help raise the next litter. Dingoes sometimes mate with domestic dogs.

Dingoes commonly search for food at night. They feed on rotting meat and on such mammals as rabbits and wallabies. In times of drought, dingoes may also kill and eat calves, sheep, and other farm animals. As a result, some farmers offer rewards to hunters who trap or kill dingoes. But the dogs also benefit farmers by killing such pests as rabbits and wild pigs. Anne Innis Dagg

Scientific classification. The dingo belongs to the family Canidae. Most scientists consider it a wild type of domestic dog, *Canis familiaris dingo*, while others consider it a distinct species, *Canis dingo.*

Dinka, *DIHNG kah,* are a cattle-herding people of southern Sudan in central Africa. They make up the largest black ethnic group in Sudan. Most of the nearly 6 million Dinka live on the plains, where they herd cattle, fish, and grow a grain called *millet.* The Dinka milk their cattle but seldom kill the animals for meat.

The Dinka language belongs to the Nilo-Saharan family of African languages, which also includes Nuer and Maasai. Many Dinka also speak English.

The Dinka religion includes belief in a supreme creator called *Nhialic* and in many spirits. Ritual leaders called *masters of the fishing spear* lead religious ceremonies and settle disputes. The Dinka believe that the masters of the fishing spear have spiritual power, which the masters use to provide health and prosperity for their people. Some Dinka have become Christians or Muslims, but most practice their traditional religion.

Arabic-speaking Muslims in northern Sudan have controlled Sudan's government since the nation gained independence in 1956. In the 1980's, the Dinka and other southern peoples formed an opposition group called the Sudan People's Liberation Army to fight for independence. The Dinka have suffered brutal civil war and famine as they battle for independence. Elliot Fratkin

See also Maasai; Nuer; Sudan (Independence).

Dinkins, David Norman (1927-), became the first African American mayor of New York City, in 1990. Dinkins, a Democrat, became mayor after defeating Rudolph W. Giuliani in the 1989 general election. Dinkins is a liberal who became known for his skill in solving conflicts. In 1993, Dinkins ran for reelection, again against Giuliani, but was defeated. Dinkins left office in 1994.

Dinkins was born on July 27, 1927, in Trenton, New Jersey. He earned a bachelor's degree in mathematics from Howard University in Washington, D.C. In 1956, he graduated from Brooklyn Law School. Dinkins was elected to the New York Legislature in 1965 and served one term. He was city clerk of New York City from 1975 to 1985. He then was elected president of Manhattan, one of the five boroughs of New York City. Guy Halverson

Dinoflagellate, *DIH nuh FLAJ uh layt* or *DY noh FLAJ uh layt,* is a kind of one-celled organism found in oceans and freshwater lakes and ponds. Scientists classify dinoflagellates in a group of living things called *protists.* Some dinoflagellates function as plants. They need only sunlight and certain nutrients for growth. Other kinds live more as animals do, and consume bacteria and other tiny organisms. Still other kinds change back and forth between a plantlike and an animallike lifestyle.

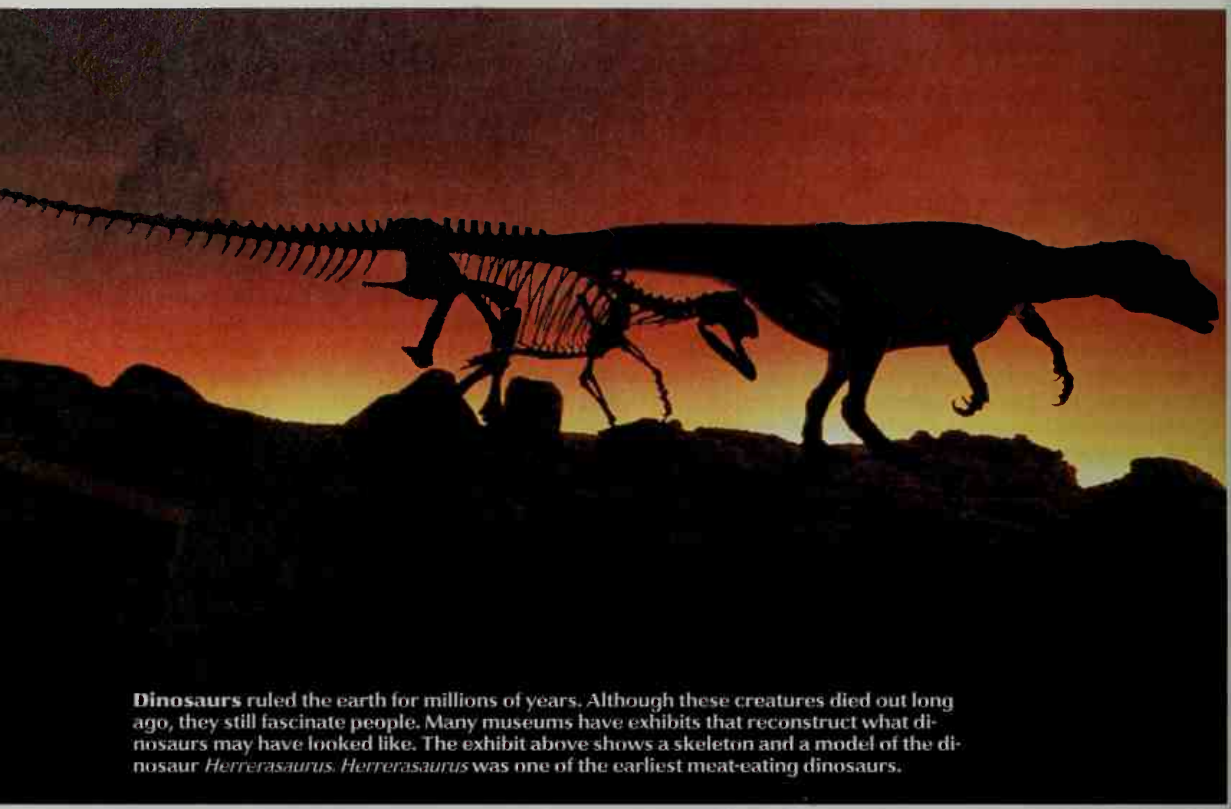
Typical dinoflagellates have two *flagella* (long, hairlike projections) that enable them to swim. Many possess thick cell walls that look like plates of armor. Some can even produce a chemical light called *bioluminescence.*

Dinoflagellates change form during their life cycle. Most go through an active, swimming stage of life and a more stationary stage. In the stationary period, some dinoflagellates develop into thick-walled, seedlike forms called *cysts.* Scientists believe that cysts settle at the bottom of oceans and lakes, enabling dinoflagellates to survive when water conditions are unfavorable for growth.

Dinoflagellates make up part of *plankton,* a drifting mass of water organisms. Plankton provides food for much sea life. However, a few dinoflagellates produce powerful poisons that kill fish. When dinoflagellates become abundant, they may discolor the water, causing *red tides.* Red tides can harm marine life if they contain poisonous dinoflagellate species, or if the dinoflagellates remove all oxygen from the water. Harmful red tides often occur in coastal waters. David L. Garrison

Scientific classification. Dinoflagellates belong to the kingdom Protista.

See also **Pfiesteria; Plankton; Protist; Red tide.**



Dinosaurs ruled the earth for millions of years. Although these creatures died out long ago, they still fascinate people. Many museums have exhibits that reconstruct what dinosaurs may have looked like. The exhibit above shows a skeleton and a model of the dinosaur *Herrerasaurus*. *Herrerasaurus* was one of the earliest meat-eating dinosaurs.

© 1994 Stephen and Sylvia Czerkas from The Field Museum, Chicago (Neg.#GEO-85866.10)

Dinosaur

Dinosaur is the name of a group of prehistoric reptiles that ruled the earth for about 160 million years. These animals died out millions of years ago, but they have fascinated people ever since they were first described in the early 1800's. The name *dinosaur* comes from the term *Dinosauria,* which means *terrible lizards.* But dinosaurs were not lizards, only distantly related to them, and most were not very terrible.

Some of the best-known dinosaurs were terrifying, however. Many were of enormous size. Some dinosaurs towered above and weighed more than any other animal ever to live on land. The largest dinosaurs may have grown as long as 150 feet (45 meters) and weighed as much as 85 short tons (77 metric tons). Such giants would have been more than 10 times as heavy as a full-grown elephant. The only animals that grow to this size today are a few kinds of whales, and they live only in the water. Size was not the only characteristic that made some dinosaurs terrifying. Many large dinosaurs were fierce and deadly meat-eaters.

The first dinosaurs appeared on the earth about 230 million years ago. They lived in nearly all natural settings, from open plains to forests to the edges of swamps, lakes, and oceans. Then about 65 million years ago, the dinosaurs died out.

Dinosaurs varied greatly in how big they grew, how they looked, and where they lived. Some of the most famous were such gigantic animals as *Apatosaurus, Diplodocus,* and *Tyrannosaurus*—pronounced *uh PAT uh SAWR uhs, duh PLAHD uh kuhs,* and *tih RAN uh SAWR uhs. Apatosaurus* (formerly called *Brontosaurus)* grew about 70 feet (21 meters) long. *Diplodocus* reached an even greater length—about 90 feet (27 meters). Both *Apatosaurus* and *Diplodocus* were plant-eaters. Each had a small head and an extremely long neck and tail. *Tyrannosaurus* was a fierce meat-eater. It stood almost 12 feet (3.7 meters) tall at the hips and had an enormous head and long, pointed teeth. But not all dinosaurs were giants. The smallest kinds were approximately the size of a chicken.

In certain ways, dinosaurs were like many modern reptiles. For example, some dinosaurs had teeth and skin much like those of alligators living today. Many were probably about as intelligent as crocodiles and alligators. However, dinosaurs also differed from present-day reptiles in many ways. For example, no modern reptiles grow as large as the biggest dinosaurs. In addition, many kinds of dinosaurs were *bipedal*—that is, they walked on their hind legs. Dinosaurs also had a different

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kind of leg posture. Lizards, turtles, and most other modern reptiles hold their legs out to the sides of their body in a low, sprawling posture. But dinosaurs held their legs under their body, much like those of a bird, a horse, a dog, or a person. This upright posture enabled dinosaurs to walk on all four legs without dragging their bellies on the ground.

Dinosaurs lived during most of the Mesozoic Era. This period in the earth's history lasted from about 248 million to 65 million years ago. The Mesozoic is sometimes called the *Age of Reptiles* or *Age of Dinosaurs* because dinosaurs and other reptiles were the largest animals during that time. Dinosaurs belonged to a group of closely related animals called *archosaurs (AHR kuh sawrs,* meaning *ruling reptiles).* However, not all archosaurs were dinosaurs. Other well-known members of this group included *crocodilians* (alligators and related animals) and *pterosaurs (TEHR uh sawrs,* meaning *winged reptiles).* By about 65 million years ago, nearly all archosaurs and many other creatures had died out, and the Mesozoic Era came to an end.

Scientists do not know why dinosaurs died out. For many years, scientists thought that dinosaurs had left no *descendants* (offspring). But since the 1960's, dinosaur research has indicated that birds descended from particular kinds of small, meat-eating dinosaurs. This research has led many scientists to classify birds as living dinosaurs.

Scientists learn about dinosaurs by studying their fossils, which include preserved dinosaur bones, teeth, eggs, nests, tracks, skin imprints, and waste material. Scientists also study living animals that resemble dinosaurs in some ways.

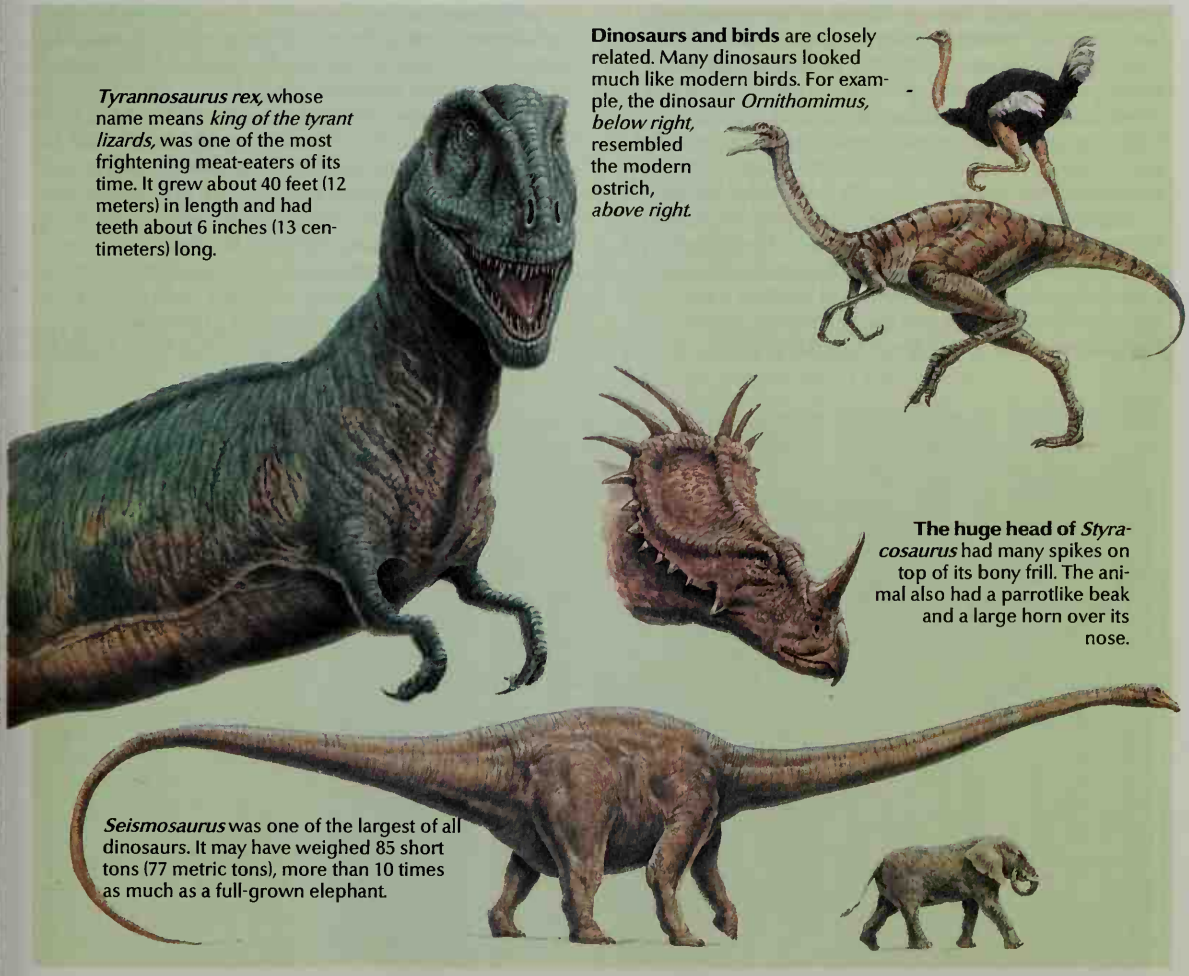
The world of the dinosaurs

When dinosaurs lived, the earth was much different than it is today. For example, the Alps, the Himalaya, and many other surface features had not yet formed. The first flowering plants did not appear until late in the Mesozoic Era. Mammals, which evolved at about the same time as dinosaurs, were extremely small during the Mesozoic. In addition, many plants and animals that are now extinct or rare were common then.

Land and climate. Scientists believe the earth's continents have not always been arranged as they are today. About 250 million years ago, they formed a single land

Interesting facts about dinosaurs

WORLD BOOK illustrations by Tim Hayward, Bernard Thornton Artists



mass surrounded by an enormous sea. During the Mesozoic Era, this land mass began to break apart to form the continents and oceans that we know today. The continents slowly drifted away from each other toward their present locations.

As the continents moved, their surface features and climate changed. For a time, huge, shallow seas covered portions of North America, Europe, Africa, and Asia. Thick forests bordered drier plains, and swamps and deltas lined the seacoasts. Later in the Mesozoic, the seas drained from the continents and the Rocky Mountains began to form.

Throughout the Mesozoic, dinosaurs lived in a climate that was milder and less changeable than the climate today. Areas near the seas and along rivers and lakes may have had mild, moist weather all year. Inland regions were drier and, in some cases, desertlike. Toward the end of the Age of Reptiles, the climate grew cooler and drier and the change of seasons became more distinct.

Plant and animal life also changed during the Mesozoic Era. During the first half of the era, primitive forms of *conifers* (cone-bearing trees), *cycads* (palmlike trees), and ginkgoes were among the most common plants. Other plant life included ferns, giant horsetails, and mosses. Land animals, in addition to dinosaurs, included crocodilians, frogs, insects, lizards, turtles, and a few kinds of small mammals. Many reptiles lived in the seas, including *ichthyosaurs (IHK thee uh sawrs),* which resembled porpoises, and *plesiosaurs (PLEE see uh sawrs),* which had long necks. Other Mesozoic sea creatures included clams, corals, jellyfish, snails, sponges, squids, and starfish, as well as sharks and many other primitive varieties of fish. Flying pterosaurs dominated the skies.

During the second half of the Mesozoic Era, the first flowering plants began to appear. Forest trees included the first modern conifers as well as primitive magnolias, oaks, palms, and willows. Birds had evolved from small meat-eating dinosaurs, and the first snakes appeared. The dominant sea animals were gigantic lizards called *mosasaurs (MOH suh sawrs).* These animals had flippers instead of legs. Other sea creatures included huge turtles and the first modern bony fish.

Kinds of dinosaurs

Dinosaurs lived throughout most of the Mesozoic Era, which is divided into three periods—Triassic, Jurassic, and Cretaceous. The Triassic Period lasted from about 248 million to 213 million years ago. The Jurassic lasted from about 213 million to 145 million years ago, and the Cretaceous from about 145 million to 65 million years ago.

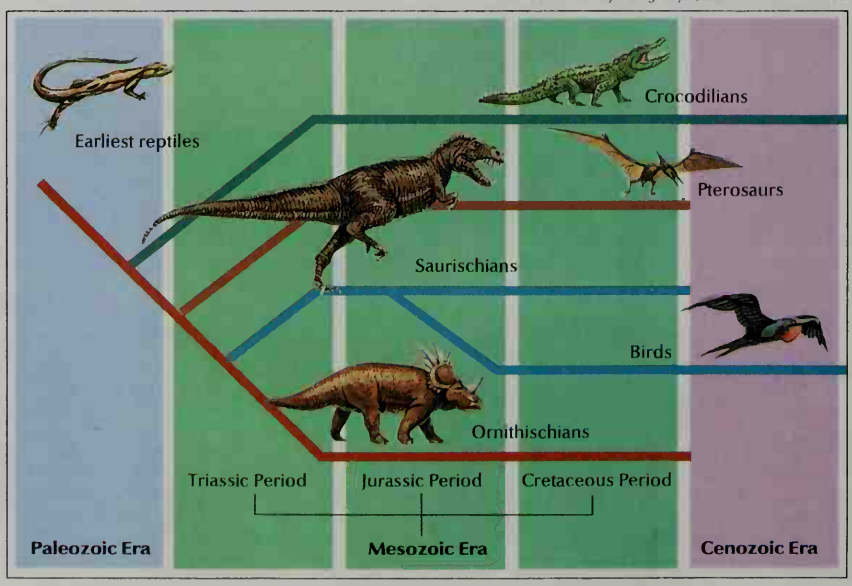
Dinosaur ancestors. Dinosaurs probably evolved from the same ancestors as crocodilians and other archosaurs. Scientists believe the ancestors were small, meat-eating reptiles. These agile predators hunted prey by chasing after it on their hind legs and sometimes on all four legs. Scientists have discovered fossils of several kinds of archosaurs that lived at the beginning of the Mesozoic.

One possible dinosaur ancestor is *Lagosuchus,* whose name is pronounced *luh GAHS uh kuhs* and means *rabbit crocodile. Lagosuchus* was a small reptile from the Triassic Period whose fossils have been found in what is now Argentina. It was one of the most active predators of its time, and it had many of the characteristics of fully developed dinosaurs. For example, its long neck curved in an S-shape, a feature typical of many dinosaurs. True dinosaurs probably evolved from *Lagosuchus* and other early archosaurs.

True dinosaurs. Scientists divide true dinosaurs into two major groups: (1) ornithischians *(awr nuh THIHS kee uhns)* and (2) saurischians *(saw RIHS kee uhns).* The two groups differed mostly in the structure of their hips and other skeletal features. Ornithischians, whose name means *bird-hipped,* had a birdlike hip structure. Saurischians, whose name means *lizard-hipped,* had a hip formation much like that of lizards. Both groups consisted of several recognizable kinds of dinosaurs.

Ornithischians were plant-eaters. They had a beaklike

WORLD BOOK illustrations by George Fryer, Bernard Thornton Artists



Dinosaur family tree. The ancestors of all dinosaurs were small, lizardlike reptiles. These early reptiles first appeared about 330 million years ago, during the Paleozoic Era. The two major kinds of dinosaurs—ornithischians and saurischians—lived throughout most of the Mesozoic Era (248 million to 65 million years ago). The Mesozoic is divided into three periods—the Triassic, Jurassic, and Cretaceous. Dinosaurs died out at the end of the Cretaceous. Birds, which descended from saurischians, survived into the Cenozoic Era, which began 65 million years ago and continues today.

bone in front of their lower jaw, and many had bony plates in their skin. During the Cretaceous Period, ornithischians became the most important plant-eating dinosaurs. There were five basic kinds of ornithischians: (1) stegosaurs, (2) ankylosaurs, (3) ornithopods, (4) pachycephalosaurs, and (5) ceratopsians. Each group included many different species.

Stegosaurs *(STEHG uh sawrs)* were large plant-eaters with huge, upright bony plates or spines along the back. They lived from the middle of the Jurassic to the middle of the Cretaceous. One of the best-known stegosaurs is *Stegosaurus,* which lived in what is now North America. Other stegosaurs lived in Africa, Europe, India, and China. Stegosaurs walked on four legs. The largest stegosaurs measured about 30 feet (9 meters) long and about 6 feet (1.8 meters) tall at the hips. They had a small head and a short neck. Stegosaurs' front legs were much shorter than their back ones. Because of the difference in leg length, stegosaurs walked with their head close to the ground, making them look bent over.

Some stegosaurs had two rows of spines along their back, while others had two rows of stiff, vertical plates. The tail was armed with pairs of bony spikes. Some scientists believe that the plates and spikes may have helped protect the animals from enemies. Other scientists also suggest that the plates helped control the animal's body temperature. According to this theory, overheated blood was pumped through the thin plates and returned to the rest of the body. Air moving around the stegosaur's back would have cooled the blood as it flowed through the plates. The plates could also have warmed the blood by absorbing heat from the sun.

Ankylosaurs *(AHNG kuh luh sawrs)* were the most heavily armored of all dinosaurs. They were low, broad animals and walked on four legs. Most kinds of ankylosaurs grew 15 to 30 feet (5 to 9 meters) long and had a skull 2.5 feet (80 centimeters) long. Heavy, bony plates covered the body and head of most ankylosaurs. Many of the plates had ridges or spikes. In some ankylosaurs, large spikes also grew at the shoulders or at the back of the head. Some kinds of ankylosaurs had a large mass of bone at the end of the tail. This bone could be used as a powerful club against enemies.

Ankylosaurs lived in many parts of the world from the middle Jurassic to the end of the Cretaceous. These tank-like animals were some of the most successful plant-eating dinosaurs. They most frequently ate the leaves of ferns and low-growing flowering plants.

Ornithopods *(AWR nuh thuh pahds)* could walk either on four legs or on their two hind legs. One of the first dinosaur fossils ever discovered was that of an ornithopod's tooth. This animal, called *Iguanodon (ih GWAN uh dahn),* measured about 30 feet (9 meters) long. *Iguanodon* had a bony spike on the thumb of each forelimb. Other ornithopods, such as *Heterodontosaurus (HEHT uhr uh DAHN tuh sawr uhs),* grew only about 4 feet (1.2 meters) long.

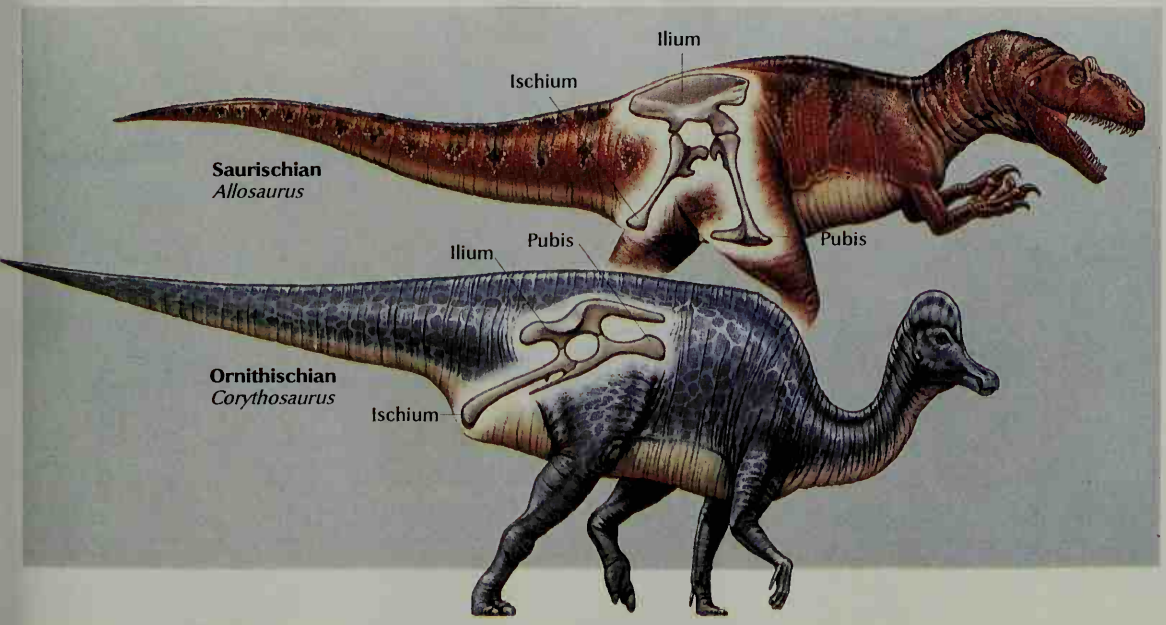
Ornithopods lived throughout the Mesozoic. But they reached their greatest development in hadrosaurs *(HAD ruh sawrs),* also known as duckbilled dinosaurs. Hadrosaurs lived at the end of the Cretaceous, mostly in what are now Asia and North America. They also inhabited Europe and South America. Hadrosaurs had a broad, ducklike beak at the front of the mouth. They also had jaws with hundreds of teeth farther back in the mouth, which they used to chew tough plant leaves. Their hind legs were strong, and they carried their tails stiffly outstretched and parallel to the ground. Some hadrosaurs were 9 feet (2.7 meters) tall at the hips and more than 30 feet (9 meters) long.

Hadrosaurs such as *Prosaurolophus (proh SAWR uh lahf uhs)* and *Edmontosaurus (ehd MAHN tuh SAWR uhs)* had skulls that were either flat or arched into a bony crest. Other kinds of hadrosaurs, such as *Corythosaurus*

Text continued on page 208.

Kinds of dinosaurs

Scientists divide dinosaurs into two major groups—ornithischians and saurischians—according to the structure of the hips. Ornithischians, such as *Corythosaurus,* had a birdlike hip structure. Saurischians, such as *Allosaurus,* had hips like those of lizards. The two groups differed in the three bones that made up the hipbone—the *ilium, ischium,* and *pubis.*



When dinosaurs lived

Dinosaurs lived during most of the Mesozoic Era, which is divided into three periods—the Triassic (248 million to 213 million years ago), the Jurassic (213 million to 145 million years ago), and the Cretaceous (145 million to 65 million years ago). These illustrations and the ones on the next page include dinosaurs from each of these periods.

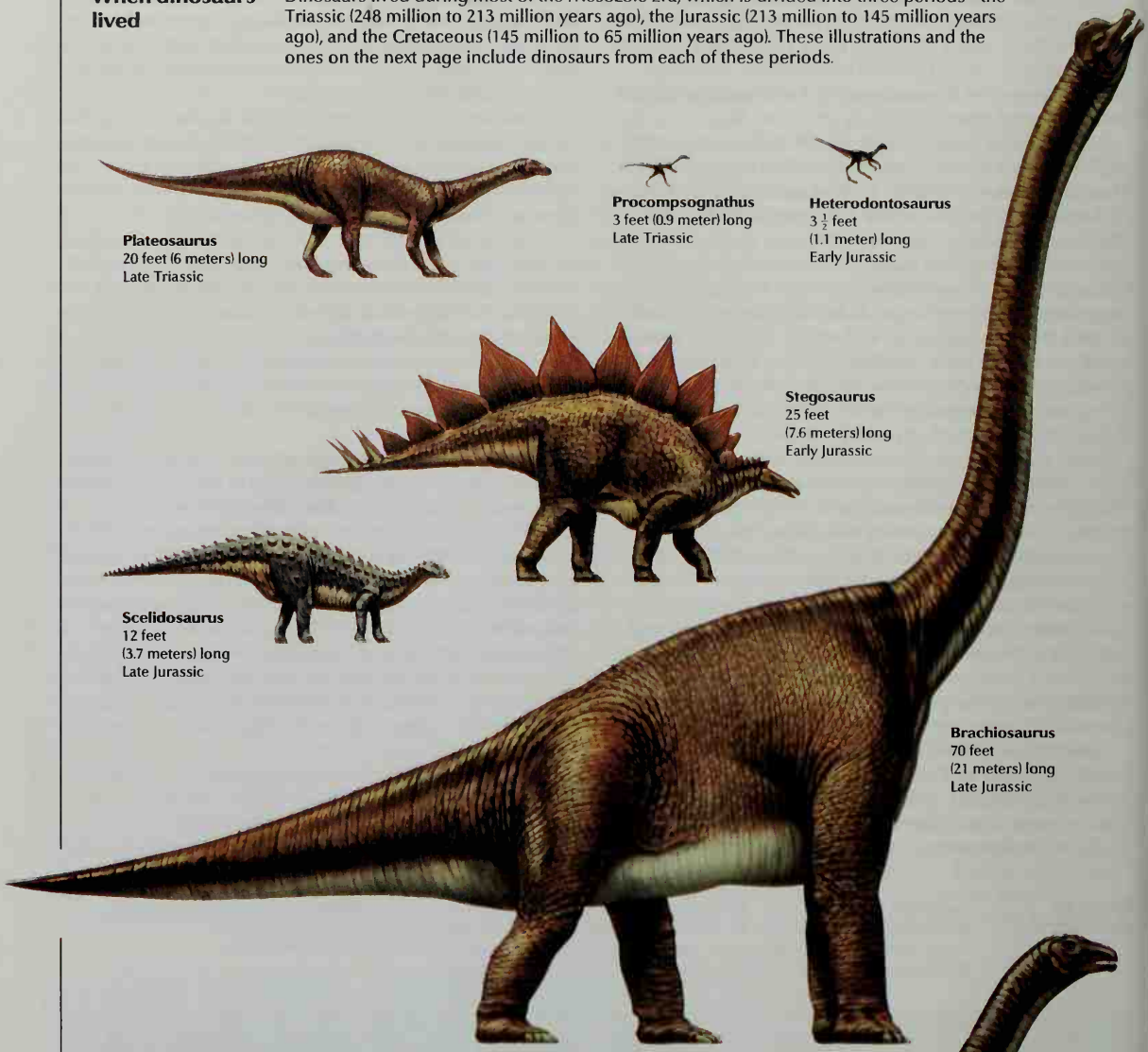
Plateosaurus
20 feet (6 meters) long
Late Triassic

Procompsognathus
3 feet (0.9 meter) long
Late Triassic

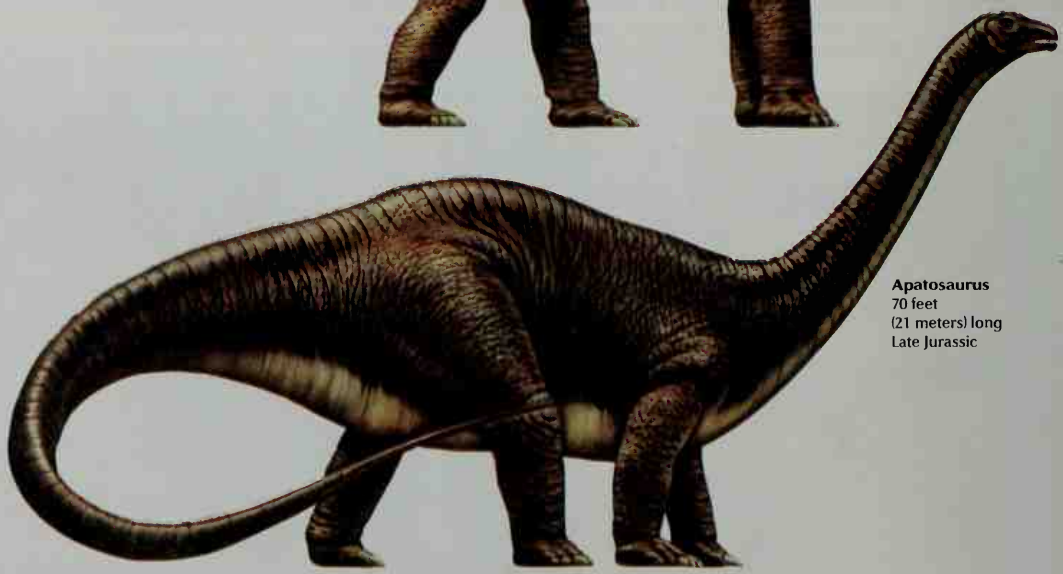
Heterodontosaurus
3 $\frac{1}{2}$ feet
(1.1 meter) long
Early Jurassic

Stegosaurus
25 feet
(7.6 meters) long
Early Jurassic

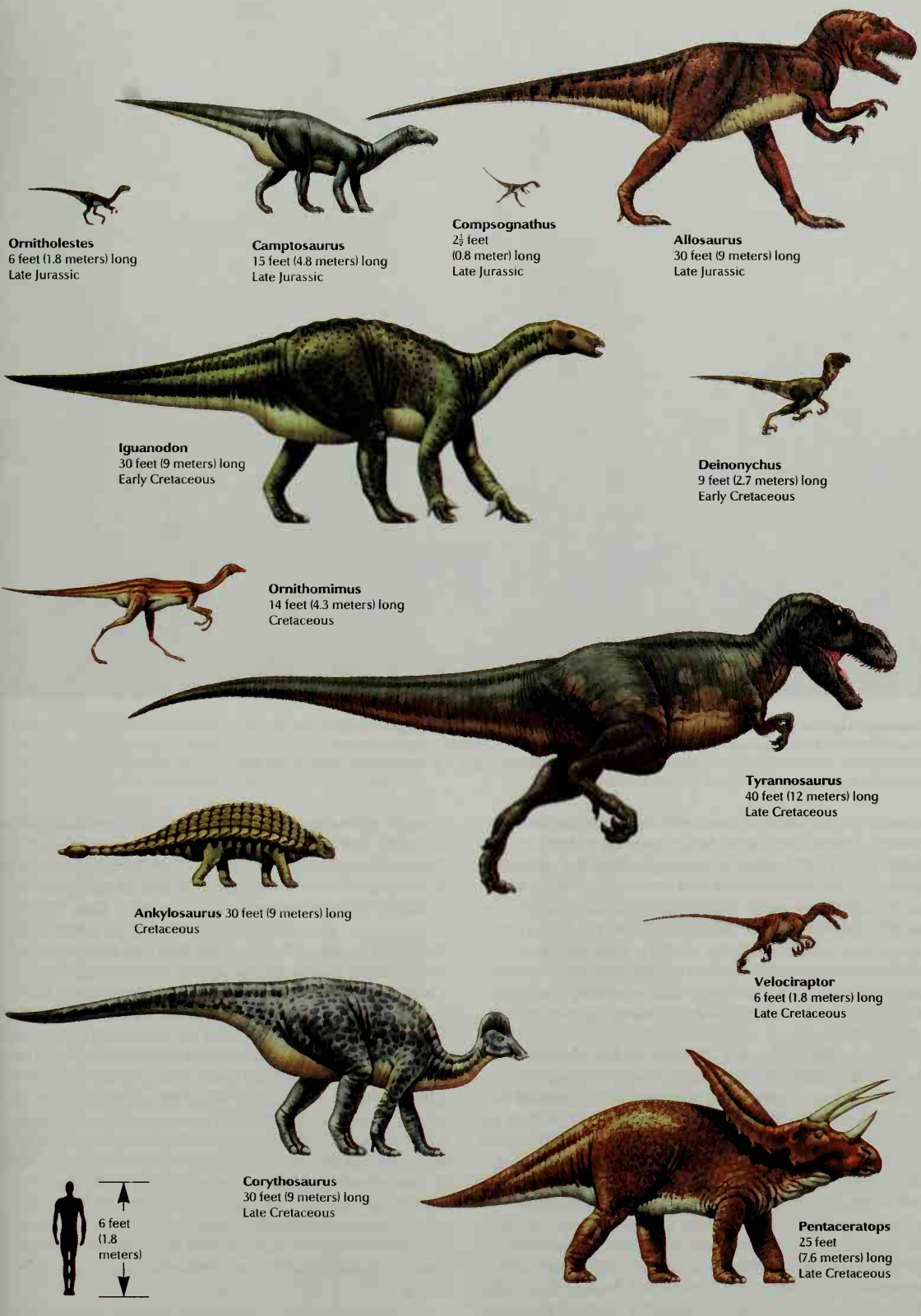
Scelidosaurus
12 feet
(3.7 meters) long
Late Jurassic

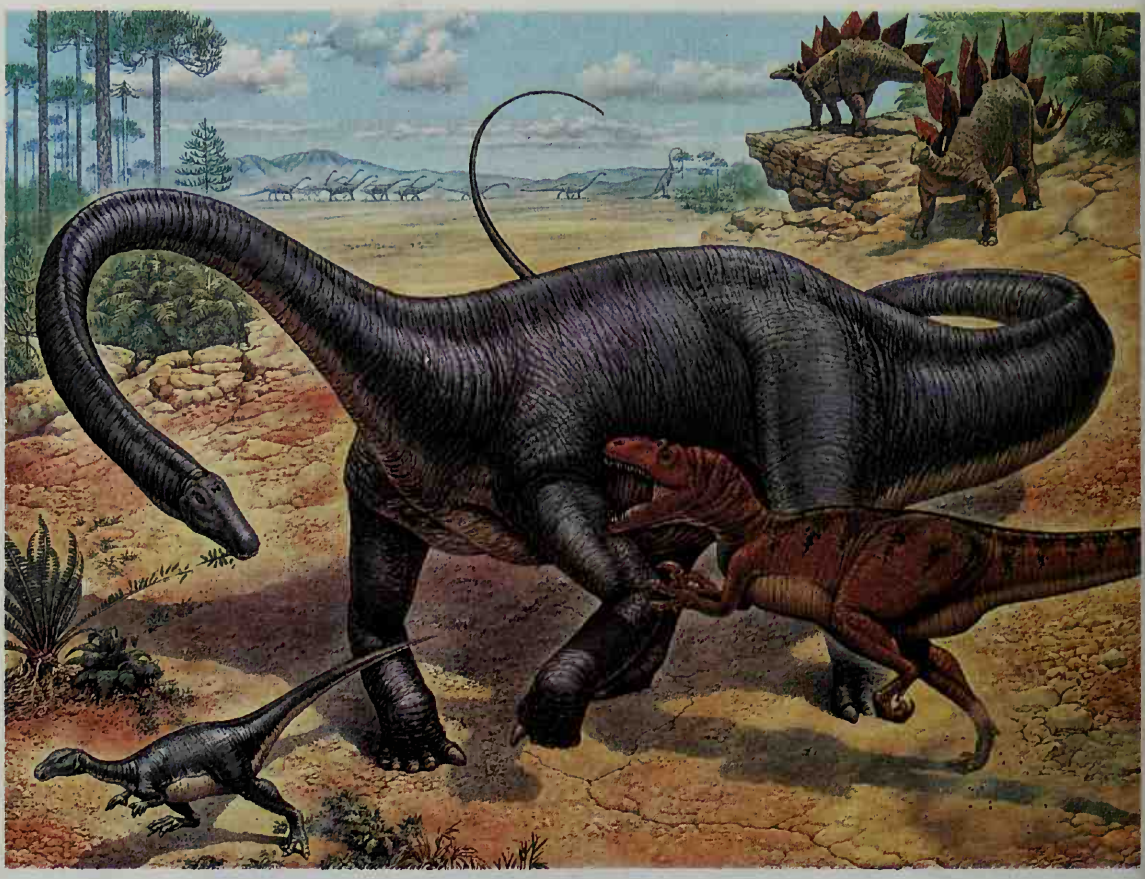


Brachiosaurus
70 feet
(21 meters) long
Late Jurassic



Apatosaurus
70 feet
(21 meters) long
Late Jurassic


Ornitholestes
6 feet (1.8 meters) long
Late Jurassic
Camptosaurus
15 feet (4.8 meters) long
Late Jurassic
Compsognathus
2½ feet
(0.8 meter) long
Late Jurassic
Allosaurus
30 feet (9 meters) long
Late Jurassic
Iguanodon
30 feet (9 meters) long
Early Cretaceous
Deinonychus
9 feet (2.7 meters) long
Early Cretaceous
Ornithomimus
14 feet (4.3 meters) long
Cretaceous
Tyrannosaurus
40 feet (12 meters) long
Late Cretaceous
Ankylosaurus 30 feet (9 meters) long
Cretaceous
Velociraptor
6 feet (1.8 meters) long
Late Cretaceous
Corythosaurus
30 feet (9 meters) long
Late Cretaceous
Pentaceratops
25 feet
(7.6 meters) long
Late Cretaceous
6 feet
(1.8
meters)



Dinosaurs of the Jurassic Period (213 million to 145 million years ago) included the huge *Diplodocus* and the meat-eating *Allosaurus, shown at center.* Another Jurassic dinosaur, *Stegosaurus, in the background,* had stiff bony plates along its back. *Camptosaurus, pictured in the lower left corner,* could walk on its two hind legs.

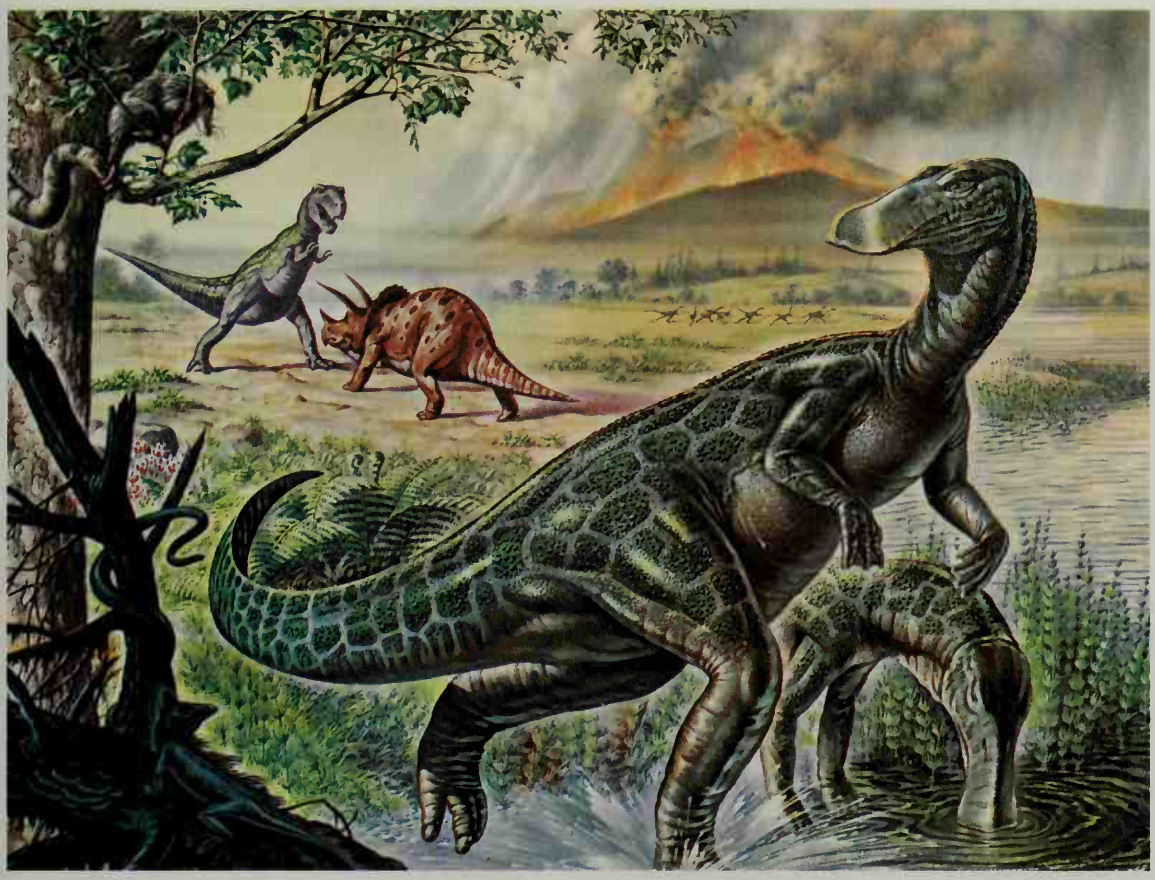
(kaw RIHTH uh SAWR uhs) and *Parasaurolophus (PAIR uh SAWR uh LAHF uhs),* had a showy crest on the top of the head. This crest housed air passages from the animal's nose. Some scientists think that hollow-crested hadrosaurs could have made loud honking sounds when they exhaled through the air passages. These honks may have resembled sounds made by modern elephants and whales. Scientists also believe hadrosaurs took care of their young, tending the nests and providing the babies with food and protection. Most modern reptiles do not care for their young.

Pachycephalosaurs *(PAK uh SEHF uh loh sawrs)* were the dome-headed ornithischians. They lived mostly in western North America and Asia during the second half of the Cretaceous Period. Pachycephalosaurs walked on their hind legs, and most measured from 6 to 25 feet (1.8 to 8 meters) long. These dinosaurs had extremely thick skulls, often covered with bumps and spikes. Scientists believe that pachycephalosaurs used their heads in butting matches, much as male bighorn sheep do today.

Ceratopsians *(SEHR uh TAHP see uhns)* are known as the horned dinosaurs because most of them had horns. Most walked on four feet, resembled rhinoceroses, and ranged in length from about 6 to 25 feet (1.8 to 8 meters). Ceratopsians' heads were often enormous. They typically had a parrotlike beak and a bony frill extending across the neck from the back of the skull. One ceratopsian, *Torosaurus (tawr oh SAWR uhs),* had the largest head of any animal ever to live on land. This head measured about 8.5 feet (2.6 meters) long. In another kind, *Styracosaurus (sty RAK uh SAWR uhs),* the margin of the frill had many spikes. Most ceratopsians had horns on the face, usually one on the nose and one over each eye. *Centrosaurus (SEHN troh SAWR uhs),* for example, had one large horn on the nose and two smaller ones over the eyes. *Triceratops (try SEHR uh tahps)* had horns over the eyes that grew up to 3 feet (90 centimeters) long. Earlier ceratopsians, such as *Psittacosaurus (SIHT uh koh SAWR uhs), Protoceratops (PROH tuh SEHR uh tahps),* and *Leptoceratops (LEHP tuh SEHR uh tahps),* were hornless. Ceratopsians lived during the Cretaceous Period in what are now Asia and North America.

Saurischians included both the largest and the fiercest dinosaurs. There were two basic kinds of saurischians: (1) sauropodomorphs *(SAWR uh PAHD uh mawrphs)* and (2) theropods *(THUR uh pahds).* Each of these groups included many different kinds of dinosaurs.

The earliest sauropodomorphs, such as *Plateosaurus (PLAT ee oh SAWR uhs),* lived during the late Triassic



Dinosaurs of the Cretaceous Period (145 million to 65 million years ago) included hadrosaurs, *center,* which had wide, ducklike bills. Other dinosaurs included the fierce, meat-eating *Tyrannosaurus rex* and the horned *Triceratops, both upper left.* Flowering plants appeared during this period, and opossums, snakes, and lizards were common.

Period. These dinosaurs had a long neck and a small head and grew almost 30 feet (9 meters) long. Animals like *Plateosaurus* were the first diverse and widespread plant-eating dinosaurs. They fed on the tall trees of the period. Early sauropodomorphs could walk on their two hind legs as well as on all four legs.

Sauropods, the later sauropodomorphs, were the giants of the dinosaur world. The largest ones included *Seismosaurus (SYZ muh SAWR uhs),* which may have grown to a length of 150 feet (45 meters), and *Supersaurus (SOO pur SAWR uhs),* which was about 98 feet (30 meters) long. Most sauropods were 30 to 60 feet (9 to 18.3 meters) in length. Adults usually weighed from 10 to 30 short tons (9 to 27 metric tons). Sauropods walked on four stout, strong legs, much like those of an elephant. All sauropods had a long neck, a small head, a long tail, and a huge, deep chest and stomach region. Sauropods were the largest plant-eaters, feeding on the tops of tall trees such as conifers. During the Cretaceous Period, they declined in importance in the Northern Hemisphere. But they remained the dominant plant-eaters in what are now South America, India, and Africa. These regions were almost completely in the Southern Hemisphere at that time.

One of the best-known sauropods is *Apatosaurus.* More than any other dinosaur, *Apatosaurus* brings to mind the image of a dinosaur for many people. Its front legs were shorter than its hind legs, and its back sloped down toward the base of its neck. *Diplodocus* looked much like *Apatosaurus* but was slimmer and longer. Both *Apatosaurus* and *Diplodocus* lived during the Jurassic Period in what is now North America.

Brachiosaurus (BRAK ee uh SAWR uhs), another kind of sauropod, lived in Africa and North America at the same time as *Apatosaurus* and *Diplodocus.* With its neck stretched upward, *Brachiosaurus* stood about 50 feet (15.2 meters) tall. It weighed about 85 short tons (77 metric tons). The animal's front legs were longer than its hind legs, and its back sloped down toward the tail. These features gave *Brachiosaurus* a stance much like that of a giraffe.

Theropods were the only meat-eating dinosaurs. These powerfully built animals walked upright on their two hind legs. Their short, slender forelimbs ended in hands that could grasp objects fairly well. Nearly all theropods had a long, muscular tail, which they carried straight out behind them for balance. Large theropods had a short neck and a large, long head. Small theropods had longer necks and a smaller head. Some theropods were toothless. Others had sharp teeth and strong

Text continued on page 211.

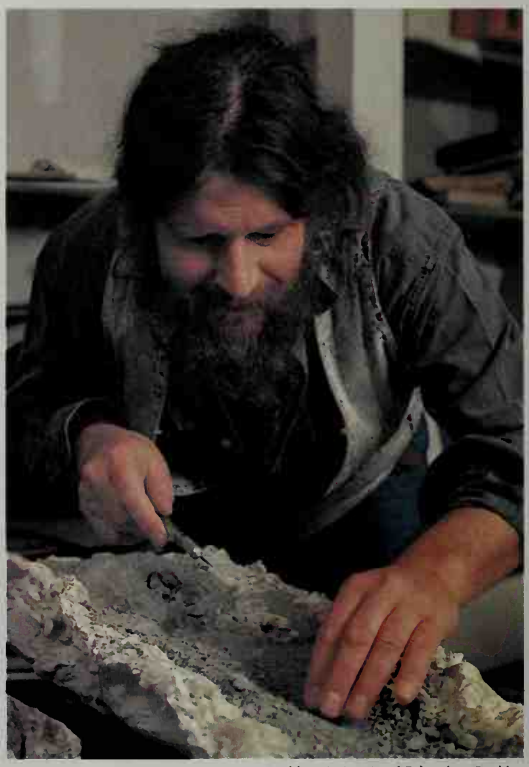
A World Book special feature

Working with dinosaur fossils

Scientists called *paleontologists* learn about dinosaurs by studying dinosaur fossils.

Ken Abbott, University of Colorado at Boulder

Paleontologists find fossils in areas where deep, fossil-bearing layers of rock are exposed. After locating fossil material, scientists begin to remove the rock around the fossil. In many cases, they dig out the portion of the rock that contains the fossil. They then ship the rock and fossil to a laboratory.



Ken Abbott, University of Colorado at Boulder

At the laboratory, scientists carefully study the fossils. Fossil remains can tell scientists many things about dinosaurs. A dinosaur tooth, for example, may indicate whether the animal ate meat or plants. Other dinosaur remains can show how large the creature grew, how fast it ran, or how it killed prey.

John Weinstein © The Field Museum, Chicago (Neg#GN86807.10)

A museum display of a dinosaur skeleton, such as this *Brachiosaurus*, consists of fossilized bones mounted on a metal or plastic framework. Missing bones may be replaced with pieces made from fiberglass, plaster, or plastic. Scientists rarely discover all the bones of a large dinosaur, and so they estimate the animal's length based on the bones that were found.

jaws, which helped make them the fiercest predators of the Mesozoic.

Two important groups of theropods were the allosaurs *(AL uh sawrs)* and ceratosaurs *(suh RAT uh sawrs).* Allosaurs were the main meat-eating dinosaurs during the Jurassic Period. Most were about 30 to 40 feet (9 to 12 meters) long. Allosaurs had forelimbs with three fingers on each limb. In contrast, most ceratosaurs were small. One example, *Coelophysis (see loh FY sihs),* was about 10 feet (3 meters) long. These animals were fast, active predators. By studying them, scientists have learned much about the early evolution of theropod dinosaurs. Many ceratosaurs lived about 230 million years ago, as the Age of Dinosaurs was just beginning.

The best known of all theropods are the tyrannosaurs *(tih RAN uh sawrs).* They ranked among the most frightening meat-eaters of their time. One famous kind is known by its scientific name, *Tyrannosaurus rex,* which means *king of the tyrant lizards.* This giant predator stood nearly 12 feet (3.7 meters) tall at the hips and grew about 40 feet (12 meters) long. Its head measured up to 4.5 feet (1.4 meters) in length, and its teeth were about 6 inches (15 centimeters) long from the base to the sharp tip. The animal had short forelegs with only two fingers, but extremely powerful hind legs. Tyrannosaurs roamed what are now western North America and east-central Asia. They lived during the second half of the Cretaceous Period.

Other dinosaurs of the Cretaceous Period included small but ferocious theropods, such as *Deinonychus (dy NAHN ih kuhs)* and *Velociraptor (vuh LAHS uh RAP tuhr).* Both grew to about 20 inches (50 centimeters) tall at the hips and 6 feet (1.8 meters) long. On each of the hind feet, there was a large, curved, razor-sharp claw used to slash, kill, and cut apart prey.

A more peaceable theropod, *Ornithomimus (awr NIHTH uh MY muhs),* looked much like a featherless ostrich with a long tail. This dinosaur was about the size of a modern ostrich and may have been just as fast a runner. Scientists think that *Ornithomimus* sprinted as fast as 30 to 40 miles (48 to 64 kilometers) per hour. These ostrich-like theropods lived during the Cretaceous Period in North America and Asia. They probably ate small fruits, the cones of certain trees, and the seeds of flowering plants, as well as eggs, insects, mammals, and lizards.

One of the most intelligent dinosaurs was a small, bipedal theropod called *Troodon (TROH uh dahn).* It lived during the late Cretaceous in North America. *Troodon*'s brain was as large, compared with its body weight, as that of many modern birds and small mammals. It had excellent vision and probably hunted for mammals and other prey at night. *Troodon* grew to about 6 feet (1.8 meters) in length. Theropods also included one of the smallest known dinosaurs, *Compsognathus (kahmp SAHG nuh thuhs).* This animal was about the size of a chicken.

How dinosaurs lived

For many years, people thought that dinosaurs were clumsy, slow-moving, unintelligent creatures that lived much like modern reptiles. However, fossil evidence suggests that some dinosaurs—especially small theropods—were much more active and intelligent than previously thought. In addition, scientists generally agree that small theropods are the closest known relatives to birds. Thus, scientists can learn much about the life of dinosaurs by studying birds and other modern animals that have some similarity to dinosaurs.

How dinosaurs lived depends partly on whether they were *ectothermic* (cold-blooded), like modern reptiles, or *endothermic* (warm-blooded), like birds and mammals. The body temperature of ectothermic animals changes with the temperature of their surroundings. For example, a lizard's body temperature rises as the air becomes warmer or the sun shines. When the air cools or the sun disappears, the lizard becomes cooler. Lizards become active when they are warm, but they are sluggish when cool. In contrast, endothermic animals generate their own heat and have a constant, fairly warm body temperature. Such animals tend to be more active than their ectothermic counterparts.

Traditionally, dinosaurs were considered ectothermic. People believed they were merely large versions of cold-blooded lizards and crocodilians. Later, scientists argued that some dinosaurs were more active and thus maintained a more constant body temperature than previously believed. However, they continued to think dinosaurs were ectothermic. Scientists pointed out that large animals, particularly gigantic dinosaurs, lost their body heat slowly. Their great size would enable them to keep a more constant body temperature even if they were cold-blooded.

Since the mid-1970's, growing numbers of scientists have argued that many, or even all, dinosaurs were probably endothermic. They point out that not all dinosaurs were gigantic, especially the babies. Smaller dinosaurs could not rely on their size to keep them warm. Other dinosaur features, such as the internal bone structure and the chemistry of the bone, also suggest that dinosaurs were endothermic.

Reproduction and growth. Scientists do not know how all dinosaurs reproduced. Fossil dinosaur eggs show that at least some dinosaurs laid hard-shelled eggs, as do modern alligators. The female may have dug a nest in the soil and deposited eggs in it. Some dinosaurs, particularly hadrosaurs, may have cared for their young from the time the babies hatched until they left the nest. Others probably left the young to survive as best they could.

Scientists can only guess how long dinosaurs lived. But they can estimate the time it took for dinosaurs to grow to adult size. The growth rate depends on whether dinosaurs were ectothermic or endothermic. Endothermic animals grow more rapidly than do ectothermic ones. If sauropods were endothermic, it probably took them about 30 years to reach their average adult weight of 30 short tons (27 metric tons). If the animals were ectothermic, however, it may have taken them 200 years or longer to grow that large.

Group life. Fossil evidence shows that more than 20 kinds of dinosaurs may have occupied a particular area at the same time. Many dinosaurs, including ceratopsians, ornithopods, sauropodomorphs, and perhaps stegosaurs, probably lived in herds the year around. Other kinds, such as ankylosaurs and tyrannosaurs, may have spent most of their life alone or in small groups.

Some scientists think that dinosaurs were brightly colored, like many modern birds, snakes, and lizards. Cer-

Text continued on page 213.

A World Book special feature

Changing interpretations of dinosaurs

Our understanding of dinosaurs has changed dramatically over the years. Scientists once thought these animals were slow-moving, unintelligent creatures that did not adapt well to changing environments. Today, however, scientists believe that dinosaurs were among the most adaptable and diverse animals that ever lived.

Tyrannosaurus rex is one of many dinosaurs about which opinion has changed greatly. People first thought this giant meat-eater was primarily a scavenger, feeding only on the decaying bodies of dead dinosaurs. They also thought it lived a sluggish life, sleeping or basking in the sun between meals.

However, scientists gradually came to believe that *Tyrannosaurus* had a much more dynamic lifestyle. Scientists now argue that it was an active predator as well as a scavenger. *Tyrannosaurus* probably stalked its prey. When close enough, it caught the victim by running toward the creature on its powerful hind legs. *Tyrannosaurus* killed the prey by clamping its strong jaws on the victim's neck. It then stripped the meat from the prey's body and swallowed it.

Today, scientists are still trying to discover more about *Tyrannosaurus*. For example, they do not know exactly how the predator used its extremely small arms. Some regard the arms as strong limbs that helped the animal grab prey. Others believe the limbs were weak and virtually useless. New research and fossil discoveries will help solve such mysteries.

© The Field Museum, Chicago (Neg#CK9T)

An early view of *Tyrannosaurus rex* showed the giant meat-eating dinosaur as a slow, rather sluggish creature. The picture above was painted in the 1930's. It depicts *Tyrannosaurus* with heavy limbs and loose-fitting skin, somewhat like the limbs and skin of an elephant. The bulky *Tyrannosaurus* confronts a *Triceratops,* but it does not attack the horned dinosaur.

© Jan Sovak

A modern illustration of *Tyrannosaurus, left,* shows a faster and more active creature. *Tyrannosaurus'* s skin is tight and scaly, making its body look athletic and limber. It is shown attacking two small ceratopsians.

tain dinosaurs perhaps attracted mates by displaying colorful body parts. For example, the crested head of a hadrosaur and the neck frill of a ceratopsian may have been vividly colored. If dinosaurs also made noises, both sounds and colors may have served to attract mates.

Getting food. Most dinosaurs were plant-eaters. They probably fed on a wealth of leaves, small fruits, and seeds from Mesozoic plants. Sauropodomorphs browsed on the leaves of tall trees, while hadrosaurs chewed on the foliage of lower branches, shrubs, and ferns. Pachycephalosaurs, ankylosaurs, ceratopsians, and stegosaurs fed on low vegetation that grew along the edges of streams and rivers or on open plains.

Nearly all theropods, large and small, were hunters. They preyed on a wide variety of plant-eating dinosaurs and possibly on each other. Some of the small theropods probably ate insects, eggs, mammals, and lizards. All theropods, and particularly the smaller ones, were extremely active and could run quickly when attacking. Such fierce animals as *Deinonychus* may have hunted their prey in packs as wolves do today. Other theropods may sometimes have been *scavengers* that picked up meat from dead animals they found.

Protection against enemies. Plant-eating dinosaurs had many forms of protection against predators. The huge size of sauropods probably kept them safe from most enemies, but their smaller offspring had to stay alert to danger. Ankylosaurs had bony plates for protection, and ceratopsians and stegosaurs probably used their horns and spikes to fight off predators. Ornithopods, ceratopsians, and other dinosaurs probably gathered in herds to discourage enemies.

Why dinosaurs died out

For about 160 million years, dinosaurs were the largest and most successful animals on land. Then about 65 million years ago, these huge archosaurs died out along with pterosaurs, mosasaurs, and many other reptiles. Mammals then became the dominant animals on the earth.

Scientists have developed many theories to explain dinosaur extinction. The two major theories involve (1) gradual climate changes and (2) the collision of an asteroid with the earth. The first theory argues that, toward the end of the Cretaceous Period, the shallow seas dried up and the climate became more varied everywhere around the globe. Winters became too cold and summers too hot for dinosaurs to survive. Dinosaurs were too large to hibernate in dens, and they had no fur or feathers for protection against the cold. They also probably had difficulty cooling off in hot weather. Thus, death and extinction came as a result of gradually colder winters and hotter summers.

The other major extinction theory claims that a large asteroid hit the earth at the end of the Cretaceous. This asteroid impact would have thrown billions of tons of dust and debris into the atmosphere. Heat from the impact may have caused huge fires worldwide. Together the clouds of smoke and debris would have blocked sunlight from reaching the surface of the earth for many months. Although the seeds and roots of plants had a good chance of surviving this lightless period, the plants themselves stopped growing and died. If the catastrophe was severe and widespread enough, plant-eating dinosaurs would have starved to death. As the plant-eaters died, so did the meat-eating dinosaurs that fed on them. In addition, the darkened skies caused land temperatures to drop below freezing for 6 to 12 months in many parts of the world. Such low temperatures further damaged the dinosaur populations.

According to the asteroid theory, small mammals and birds survived because they were protected from the cold by fur or feathers. Mammals and birds also could feed entirely on seeds, nuts, and rotting vegetation. Other survivors may have escaped extinction because they could live at the bottom of lakes or burrow underground.

Most scientists, however, feel that no single theory completely explains why dinosaurs suffered extinction. They argue that a combination of causes contributed to the dinosaurs' disappearance. In fact, experts now believe that not all dinosaurs became extinct at the end of the Cretaceous. Many scientists regard birds as living dinosaurs that survived extinction.

Dinosaur discoveries

Before the 1800's, no one knew that dinosaurs had ever existed. People who found a dinosaur tooth or bone did not know what it was. Then, two important events happened. Around 1818, an English scholar, William Buckland, obtained a large lower jaw that contained a number of sharp teeth. After studying this jaw, Buckland came to the conclusion that it was unlike any fossil previously discovered. So he gave it a new name, *Megalosaurus* (great lizard), in 1824.

At nearly the same time Mary Ann Mantell, an English amateur naturalist, found a large tooth partly buried in a rock. She showed the tooth to her husband, Gideon, a physician who collected fossils. He decided that the tooth came from a huge, iguanalike reptile, which he named *Iguanodon* (iguana tooth) in 1825.

Within a few years, the remains of several kinds of large, extinct reptiles had been discovered. In 1841, Sir Richard Owen, an English scientist, suggested that these creatures belonged to a group of reptiles unlike any living animals. In 1842, he called this group *Dinosauria* (terrible lizards). Its members later came to be known as dinosaurs.

During the late 1800's and early 1900's, large deposits of dinosaur remains were discovered in western North America, Europe, Asia, and Africa. Today, most dinosaur discoveries are made in China, Mongolia, Argentina, and Australia. Some also occur in the United States and Canada. During the late 1900's, extensive research and fossil discoveries greatly increased the number of known dinosaurs. Scientists discover and describe an average of seven new kinds of dinosaurs every year.

David B. Weishampel

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Apatosaurus
Brachiosaurus
Diplodocus
Earth
(The Mesozoic Era)
Eoraptor
Extinct animal
Fossil
Hadrosaur
Paleontology
Prehistoric animal
Pterosaur
Reptile
Stegosaurus
Triceratops
Tyrannosaurus
Velociraptor

Outline

I. **The world of the dinosaurs**
   A. Land and climate
   B. Plant and animal life
II. **Kinds of dinosaurs**
   A. Dinosaur ancestors
   B. True dinosaurs
III. **How dinosaurs lived**
   A. Reproduction and growth
   B. Group life
   C. Getting food
   D. Protection against enemies
IV. **Why dinosaurs died out**
V. **Dinosaur discoveries**

Questions

What are some theories that scientists have developed to explain why dinosaurs died out?
How did sauropodomorphs get food?
What is one kind of dinosaur that took care of its young?
Why do many scientists think that birds are living dinosaurs?
How do scientists look for dinosaur fossils?
What were the two major groups of dinosaurs? How did they differ?
Which dinosaurs were meat-eaters?
Where have some of the most important dinosaur fossil deposits been discovered?
What kinds of animals besides dinosaurs lived during the Mesozoic Era?
What are the five major kinds of bird-hipped dinosaurs?

Additional resources

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Dinosaur National Monument is located in Utah and Colorado. It is a scenic region with spectacular canyons cut by the Green and Yampa rivers. Its deposits of fossil remains of prehistoric reptiles are of scientific interest. For the area of Dinosaur National Monument, see National Park System (table: National monuments). The monument was established in 1915.

Critically reviewed by the National Park Service

Dinwiddie, *dihn WIHD ee,* **Robert** (1693-1770), was lieutenant governor of Virginia from 1751 to 1758. He was a merchant and customs officer in Bermuda before coming to Virginia, where he became acting governor. He invested in land in the Ohio region and was eager to keep the area from falling under French control. In 1753, he sent George Washington to demand that the French withdraw from western Pennsylvania, which had been claimed by Virginia. In the war that followed, Dinwiddie urged the colonies to help the English drive the French from the Ohio Valley. He quarreled with the Virginia Assembly because of its reluctance to vote funds for the war. Dinwiddie returned to England in 1758. He was born near Glasgow, Scotland. See also Washington, George (Early military career [1753-1758]).

Fred W. Anderson

Diocletian, *DY uh KLEE shuhn* (A.D. 244?-311), ruled Rome as emperor from 284 to 305. In 303, he began a persecution of Christians that is often called the *Great Persecution.* Diocletian shared the rule with three other men.

Diocletian's official name was Gaius Aurelius Valerius Diocletianus. He was born in Illyricum, a Roman province on the northeastern coast of the Adriatic Sea. Diocletian became commander of the bodyguard of Emperor Numerianus. Diocletian was proclaimed emperor by his troops in 284, after Numerianus's death.

Diocletian soon made Maximian his co-emperor. In 293, Diocletian appointed Constantius I and Galerius *caesars* (junior emperors). These appointments created a four-man rule that lasted until 305. Diocletian and Maximian then gave up their power. The shared rule, though effective, was unpopular because it increased the number of government officials. In addition, the shared rule led to more efficient collection of taxes.

Timothy David Barnes

Diogenes, *dy AHJ uh NEEZ* (412?-323 B.C.), belonged to the Cynic school of ancient Greek philosophy. According to tradition, Diogenes used a tub for shelter and walked the streets barefoot. A widely known legend tells that he carried a lamp in broad daylight, announcing that he was "in search of a human being." Diogenes is often credited with saying that he was looking for "an honest man," but there is no reliable evidence that he ever made this statement. Diogenes held up the life of animals as a model for humanity, believing that good birth, riches, and honor did not help people lead a virtuous life.

Diogenes was born at Sinope, located in Asia Minor. Pirates captured Diogenes during a journey from Athens to Aegina and offered him for sale as a slave. Diogenes told his captors he knew no trade except how to govern people. Pointing to a wealthy Corinthian, Diogenes said: "Sell me to this man, he needs a master." The Corinthian bought Diogenes and made him tutor to his sons. When Alexander the Great came to see Diogenes, who was sunning himself, he said, "Ask any favor you wish." Legend says that Diogenes replied: "Please move out of my sunlight," to which Alexander commented: "If I were not Alexander, I would like to be Diogenes." S. Marc Cohen

See also Cynic philosophy.

Dionaea. See Venus's-flytrap.

Dionysius the Elder, *DY uh NIHSH ee uhs* or *DY uh NY see uhs* (430?-367 B.C.), was a Greek tyrant and military leader who ruled in ancient Sicily for almost 40 years. He became a general at Syracuse, the largest Greek city on Sicily, in 406 B.C., during a war with Carthage. In 405 B.C., he made peace with the Carthaginians and became ruler of Syracuse. Dionysius hired many foreign soldiers, defeated armies from Carthage in 396 and 392 B.C., and extended his control over much of Sicily. He later gained control of much of southern Italy and assisted Sparta in its battles in Greece.

During the 370's B.C., the Carthaginians defeated Dionysius and forced him to give up half of Sicily. Dionysius died of fever during another war with Carthage. He was succeeded as ruler by his son Dionysius the Younger. Peter Krentz

Dionysus, *dy uh NY suhs,* was the god of wine in Greek mythology. After coming into contact with Greek culture, the Romans adopted Dionysus as their god of wine, but they called him Bacchus. In Greek mythology, Dionysus' parents were Zeus, king of the gods, and Semele, the mortal daughter of King Cadmus of Thebes. Dionysus married Ariadne, the daughter of King Minos of Crete.

The ancient Greeks associated Dionysus with violent and unpredictable behavior, especially actions caused by drinking too much wine. Most stories about Dionysus tell of his leading sessions of drunken merrymaking. Dionysus' followers at these gatherings included *nymphs* (maidens), creatures called *satyrs* that were half man and half horse or goat, and women attendants called *maenads* (see **Nymph; Satyr**).

Not all the stories about Dionysus concern drunkenness or violent behavior. Many Greeks believed that Dionysus taught people farming techniques, especially those related to growing grapes and making wine. The Greeks also dedicated the great theater in Athens to Dionysus. Their concept of tragedy in drama grew from a ceremony that honored Dionysus. The word *tragedy* comes from the Greek word *tragos,* meaning *goat.* The goat was sacred to and symbolic of Dionysus.

C. Scott Littleton

See also **Bacchus; Drama** (Greek drama).

Diopside, *dy AHP syd,* is a widely occurring mineral with a glassy luster. Diopside is sometimes used as a gemstone (see **Gem** [picture]). It belongs to a group of rock-forming minerals called *pyroxenes.* Diopside is a *silicate* rich in calcium and magnesium (see **Silicate**). Its chemical formula is $CaMgSi_2O_6$. Pure diopside is white, and it melts at 1391 °C. An impurity of iron may make the mineral light green. Diopside forms when intense heat and pressure are applied during metamorphism to limestone that consists chiefly of dolomite with silica impurities (see **Metamorphism**). Diopside also forms during the crystallization of certain kinds of *magma* (molten rock material). Robert W. Charles

Dior, *dee AWR,* **Christian** (1905-1957), is considered one of the great French fashion designers of the 1900's. In 1946, Dior founded his *couture house* (a company that creates fashion designs and apparel). His first collection, unveiled in 1947, was an immediate success. Dior's 1947 designs were called the *New Look* because they differed from fashions worn during World War II (1939-1945).

Dior's New Look fashions featured a luxurious use of fabric, including extravagant full skirts. The New Look also included a natural shoulder line instead of the padded shoulders of the early 1940's. Dior recognized the importance of novelty in fashion. He emphasized the overall look by carefully selecting accessories to harmonize with each design. During the 1950's, his designs extended into furs, hats, hosiery, jewelry, and perfumes. His international fashion business became a model for the organization of later fashion empires. Dior was born in Granville, France. Jean L. Druesedow

Dioxin, *dy AHK suhn,* is any of 75 related chemicals, all of which consist of carbon, chlorine, hydrogen, and oxygen. However, the word *dioxin* is most commonly used to refer to only one of these chemicals, the compound *2, 3, 7, 8-tetrachlorodibenzo-p-dioxin* (TCDD). Some scientists consider TCDD to be the most toxic synthetically produced chemical.

TCDD is a useless by-product of the manufacture of certain weedkillers and several other industrial processes. Disposal of the chemical is difficult because it does not readily *degrade* (break down) in soil or water. One of the most effective methods of disposing of dioxin is burning it at high temperatures. Soil and water in parts of Canada, Europe, and the United States, however, have become contaminated with dioxin because of improper disposal of industrial wastes.

The health effects of TCDD are not completely understood. The chemical is extremely deadly to certain animals, but no human deaths have been directly linked to it. However, some people have developed such health problems as headaches, stomachaches, and a severe skin rash called *chloracne* as a result of exposure to dioxin. Some researchers also believe the chemical may cause birth defects and cancer.

TCDD was first identified as a contaminant in 1957. It was present in *Agent Orange,* a weedkiller used by U.S. armed forces in the 1960's and early 1970's, during the Vietnam War. Dioxin was not recognized as a major public health hazard until the mid-1970's. Gary F. Bennett

See also **Agent Orange; Missouri** (Recent developments).

Diphtheria, *dihf THIHR ee uh* or *dihp THIHR ee uh,* is a severe, contagious infection of the upper respiratory system or the skin. It can involve serious—or even fatal—complications. During the late 1800's, diphtheria epidemics swept the United States and Western Europe. At that time, most victims were under 10 years of age. Today, diphtheria affects children and adults about equally. Widespread immunization with diphtheria vaccines, which first came into use about 1920, has greatly reduced the number of cases of diphtheria.

Cause, symptoms, and complications. Diphtheria is caused by a bacterium called *Corynebacterium diphtheriae.* This organism commonly infects the mucous membranes of the upper breathing passages, particularly the tonsils and the *pharynx* (the back of the mouth and the upper throat). The bacteria produce a *toxin* (poison), which enters the blood and is carried throughout the body. Infected individuals spread the bacteria by coughing or sneezing. People called *carriers* may harbor the bacteria without showing any symptoms of the disease. Although carriers show no symptoms, they can spread the illness to other people.

Symptoms appear about two to five days after infection. They include a sore throat, fever, and swelling of the lymph nodes in the neck. A thick, grayish membrane forms on the surface of the tonsils and pharynx and may even extend up into the nose or down into the *trachea* (windpipe) and lungs. The membrane may interfere with breathing or swallowing. In severe cases, it can completely block the breathing passages and cause death if not treated.

Diphtheria toxin can affect the heart, kidneys, and nervous system. One severe effect is heart muscle inflammation, called *acute myocarditis,* which may result in permanent heart damage. In some cases, the toxin so weakens the heart that death occurs. Effects of nerve damage include temporary paralysis of muscles in the throat and eyes, and, most seriously, of the muscles

used in breathing. Paralysis of the breathing muscles can be fatal.

Diphtheria bacteria also can infect breaks in the skin. Such infections are called *wound diphtheria* or *cutaneous diphtheria.* In most cases of wound diphtheria, a membrane does not form over the infected area. But toxins enter the bloodstream and can produce the same complications as in the respiratory infection.

Treatment. Physicians hospitalize diphtheria patients and give them *diphtheria antitoxin.* This substance neutralizes diphtheria toxin. If administered early enough, the antitoxin can minimize heart and nerve complications. If the membrane that forms in the throat blocks the breathing passages, a doctor may cut a temporary opening through the neck into the trachea. Heart failure is treated with medications. If the respiratory muscles become paralyzed, a machine called a *respirator* is used to maintain the patient's breathing. Diphtheria patients also receive antibiotics, which kill the diphtheria bacteria and help control secondary infections caused by other bacteria.

Prevention. People can obtain *immunity* (protection) from diphtheria by using vaccines that contain *diphtheria toxoid.* This toxoid is a specially treated form of diphtheria toxin. It does not damage body tissues, but it triggers the production of disease-fighting substances called *antibodies.* Antibodies formed in response to the toxoid will attack diphtheria toxin if it enters the bloodstream. Public health experts recommend that infants get a series of four diphtheria immunizations. A person should get a "booster" shot of diphtheria vaccine between the ages of 4 and 6, and about every 10 years thereafter. See **Immunization.** Michael G. Levitzky

Diphthong, *DIHP thawng* or *DIHF thawng,* is the sound produced by pronouncing two vowels as a single syllable. Examples are the *ou* in *out* and *oi* in *oil.* One sees how two sounds become a diphthong by pronouncing *ah* and *ee* in sequence slowly, then more rapidly. They become the diphthong heard in *mine,* known as *long i.* Susan M. Gass

Diplodocus, *duh PLAHD uh kuhs,* was an extremely long, slender, plant-eating dinosaur that lived about 150 million years ago in what is now the Western United States. It belonged to a group of giant, plant-eating dinosaurs known as *sauropods.* The first *Diplodocus* bones were found in 1877 near Morrison, Colo. The name *Diplodocus* means *double beam* and describes the beams of bone in the underside of the animal's tail.

Diplodocus grew to about 90 feet (27 meters) long and weighed about 11 tons (10 metric tons). The neck was about 26 feet (8 meters) long and had 15 vertebrae. The skull was relatively small, only about 2 feet (61 centimeters) long, with slender peglike teeth in the front of the mouth. The tail had more than 70 vertebrae and stretched about 45 feet (14 meters), tapering to a whiplike end. The animal could have swung the tail to defend itself against enemies. *Diplodocus* stood about 13 feet (4 meters) high from the ground to the hips. The front legs were much shorter than the hind legs. The dinosaur might have been able to stand on its hind legs, using its tail for support. *Diplodocus* ate large amounts of cycad, fern, and ginkgo leaves. Peter Dodson

See also **Dinosaur** (picture: Dinosaurs of the Jurassic Period).

Diplomacy, *duh PLOH muh see,* is the means of conducting negotiations between nations. Some scholars today also apply the term to the strategies and tactics nations use when they negotiate. In this sense, diplomacy involves formulating the policies that nations follow to influence other nations. When diplomacy fails during a major crisis, war often occurs.

Traditionally, however, diplomacy referred to the formal practice that most nations follow of sending representatives to live in other countries. These *diplomats* help carry on day-to-day relationships between their country and the country where they serve. They work to gain political or economic advantages for their country and to promote international cooperation.

Diplomatic representatives observe strict rules about rank and importance. The highest rank is ambassador extraordinary and plenipotentiary, followed by envoy extraordinary and minister plenipotentiary, minister resident, minister-counselor, counselor of embassy, secretary of embassy, and attaché. Most large nations send ambassadors to each other, and to many smaller nations. Smaller countries sometimes send and receive diplomats of lower rank. Most governments also send *consuls* to handle international business.

Each nation handles its diplomatic affairs through a foreign office. In the United States, the office that handles foreign relations is the Department of State.

Diplomatic duties. Diplomatic officers abroad are the accredited spokespersons for their governments. They gather information on everything of value to their governments and transmit it in formal reports, usually in code (see **Codes and ciphers**). Diplomatic officers also protect the rights of fellow citizens who are abroad.

Diplomats maintain their headquarters in an embassy or legation. The only difference between an embassy and a legation is the rank of the diplomat in charge. An ambassador heads an embassy, and a minister heads a legation. A diplomat's staff may include attachés and other special advisers who report on economic, political, and social conditions.

Diplomatic immunity. Diplomats enjoy several important privileges and immunities while serving abroad. These privileges arise partly because diplomats are the direct representatives of sovereign powers. Just as important, diplomats must have complete independence of action to perform their duties. A diplomat's privileges are based on the principle of *extraterritoriality.* This principle, used in international law, includes the guarantee that people living in foreign countries remain under the authority of their own governments. Four important diplomatic privileges and immunities are:

1. Diplomats cannot be arrested for any reason. Their families usually share this exemption.
2. Their residences, papers, and effects cannot be searched or seized.
3. Their personal belongings cannot be taxed by the country in which they serve.
4. Diplomats, their families, and their staffs enjoy complete freedom of worship.

History. Nations have not always used diplomacy to settle international problems. The ancient Romans used diplomatic representatives only for special purposes. But as relations among countries grew more complex, many nations found that they needed permanent repre-

sentatives in other countries. Embassies first appeared in Italy during the 1200's and 1300's. At that time, they served as headquarters for spies and espionage agents, as well as for diplomats. Many historians believe that Cardinal Richelieu of France started the system of resident representatives during the 1600's.

Through the years, formal diplomatic procedures have changed in various ways. Beginning in the 1950's, for example, U.S. Secretary of State John Foster Dulles became the first major diplomat to engage in extensive *personal diplomacy* around the world. Dulles often bypassed the appointed ambassadors in the countries he visited. In the early 1970's, U.S. Secretary of State Henry Kissinger further enhanced this practice when he engaged in *shuttle diplomacy.* He traveled back and forth among the major capitals of the Middle East in an attempt to solve an ongoing conflict there. Even heads of governments sometimes feel they need personal conferences with leaders of other governments in *summit meetings.*

Some scholars argue that diplomatic representatives are unnecessary today because of the ease of high-level exchanges and long-distance communication. But ongoing personal diplomatic contact has many advantages. Diplomats take great care to make friends with government officials and influential citizens. When they present a formal proposal, they can count on these friendships to help them. Diplomats also can test reaction to ideas their governments are considering by talking with acquaintances. Michael P. Sullivan

Related articles in *World Book* include:

Ambassador
Attaché
Consul
Diplomatic corps
Extraterritoriality
Foreign policy
Foreign Service
International relations
Legation
Logan Act
Minister
Protocol
State, Department of

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Kissinger, Henry. *Diplomacy.* Simon & Schuster, 1994.
Nolan, Cathal J., ed. *Notable U.S. Ambassadors Since 1775.* Greenwood, 1997.
Stearns, Monteagle. *Talking to Strangers: Improving American Diplomacy at Home and Abroad.* Princeton, 1996.

Diplomatic corps, *DIHP luh MAT ihk kawr,* consists of all the heads of diplomatic missions, such as ambassadors and ministers, who represent their governments in a foreign nation. The term may also refer to all the diplomatic personnel of such missions. A diplomatic mission, generally an embassy or a legation, consists of an ambassador, a minister, or a chargé d'affaires; counselors and secretaries; and various attachés.

Diplomats conduct their government's official relations with the host government, including the negotiation of treaties. They also report to their government on economic, financial, military, and political conditions in the host country. Robert J. Pranger

See also Ambassador; Diplomacy; Foreign Service.

Diplura. See Insect (table).

Dipper is the name of several species of small birds that dive and walk underwater. Dippers live along swift mountain streams in the Americas, Europe, and Asia. The *American dipper,* also called the *Mexican dipper,* is found from Alaska to Central America. In western North America, it is commonly known as the *water ouzel.* Dippers were named for their habit of bobbing up and down as they stand or walk.

WORLD BOOK illustration by Trevor Boyer, Linden Artists Ltd.

American dipper

Dippers grow 5 $\frac{1}{2}$ to 7 $\frac{1}{2}$ inches (14 to 19 centimeters) long. Most dippers have slate-gray to brown feathers. Some dippers have a white throat or head. Dippers have short wings and a short tail. They stay underwater by opening their wings and tilting them slightly upstream. The flowing water holds the birds on the stream bottom while they walk along searching for such food as water insects, flatworms, small fish, and some plant life. After feeding, the birds close their wings and bob to the surface like a cork. In the winter, they find holes in the ice to dive through.

Dippers build dome-shaped nests of moss behind waterfalls or under overhanging rocks above streams. The female dipper lays three to seven white eggs.

Donald F. Bruning

Scientific classification. Dippers belong to the family Cinclidae. The scientific name for the American dipper is *Cinclus mexicanus.*

Dippers. See Big and Little Dippers.

Diptera. See Insect (table).

Dirac, *dih RAK,* **Paul Adrien Maurice** (1902-1984), a British theoretical physicist, became noted for his mathematical equation describing the behavior of the electron. Dirac also demonstrated the fundamental unity of the two forms of *quantum mechanics,* wave mechanics and matrix mechanics (see Quantum mechanics). He shared the 1933 Nobel Prize in physics with the Austrian physicist Erwin Schrödinger for his equation and his other contributions to quantum mechanics.

Dirac introduced his equation, now called the *Dirac equation,* in 1928. It accounts theoretically for the spin of an electron and for other aspects of the particle's behavior. Dirac's theory also predicted that the negatively charged electron should have an antiparticle—a positively charged electron (see Antimatter). The American physicist Carl D. Anderson detected this positively charged electron—the *positron—in 1932.*

Dirac was born in Bristol, England. He attended Bristol and Cambridge universities. From 1932 to 1969, he held the Lucasian Professorship of Mathematics at Cambridge, a chair once held by the great English scientist Sir Isaac Newton. In 1971, Dirac became a professor of physics at Florida State University. His book *The Principles of Quantum Mechanics* (1930) is a classic in its field.

Roger H. Stuewer

See also Anderson, Carl D.; Schrödinger, Erwin.

Direct current. See Electric current; Electric generator.

Direct Selling Association is a national trade organization of companies that market goods and services through group demonstrations or person-to-person methods. Products include clothing, food, appliances, toys, housewares, jewelry, cosmetics, and reference

books. About 150 companies belong to the organization. The association conducts marketing research and offers seminars and workshops on consumer affairs, marketing, and sales training. It also monitors legislation that affects companies involved in direct selling. The association was founded in 1910. It sponsors the Direct Selling Education Foundation, a public service organization. The association's headquarters are in Washington, D.C.

Critically reviewed by the Direct Selling Association

Director. See Drama (Early realism); Motion picture (How motion pictures are made); Television (Producing television programs); Theater (The director); also the list of *Directors and producers* in the *Related articles* of Motion picture.

Dirigible. See Airship.

Dirksen, Everett McKinley (1896-1969), a Republican from Illinois, served as minority leader of the United States Senate from 1959 until his death. A skilled legislator and powerful speaker, Dirksen was probably the most influential senator of the 1960's. He worked closely with every president from Dwight D. Eisenhower to Richard M. Nixon. His deep voice, tousled hair, and theatrical manner made him one of America's best-known public figures.

Dirksen was an isolationist before the United States entered World War II in 1941. He later defended the foreign policies of both Democratic and Republican administrations. Dirksen set his own course concerning problems in America. He opposed some social legislation but supported the civil rights law of 1964.

Dirksen was born in Pekin, Illinois, and attended the University of Minnesota. From 1933 to 1949, he served in the United States House of Representatives. Dirksen was elected to the Senate in 1950 and was reelected in 1956, 1962, and 1968. David S. Broder

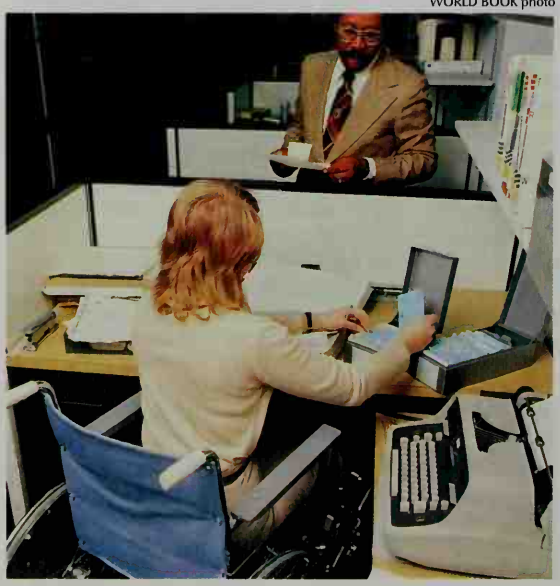
Disabled is a term used to describe people who have a physical or mental impairment that interferes with their ability to lead a happy, productive life. Physical impairments include blindness, deafness, deformity, muscular and nervous disorders, paralysis, and loss of limbs. There are two general kinds of mental impairments, mental illness and mental retardation.

An impairment may or may not be a disability. It becomes so if it interferes with a person's expectations, job performance, or relationships with his or her family, friends, and society in general. Individuals with similar impairments may not be equally disabled. For example, a history professor may not be greatly disabled by the loss of a finger. However, the same impairment would be a terrible disability to a concert pianist. People who have disabilities are sometimes referred to as *handicapped.*

There are about 35 million people with disabilities in the United States. Many common disabilities result from diseases. Heart disease may permanently decrease the victim's strength and endurance. Strokes may produce paralysis and loss of speech. Arthritis and many bone diseases can lead to deformity. Certain nerve diseases may result in blindness, deafness, and lack of coordination. Cerebral palsy is a disorder that damages the brain before, during, or after birth. Depending on what part of the brain is damaged, cerebral palsy can cause speech problems, mental retardation, muscular weakness, or involuntary movements of the arms and legs. Accidents cause a wide range of disabilities, including spinal damage and loss of limbs.

With proper motivation and special training, people with severe disabilities can lead productive, fulfilling lives. Many famous people have overcome physical impairments to make major contributions to humanity. The English poet John Milton was blind when he wrote his epic masterpiece, *Paradise Lost.* The great German composer Ludwig van Beethoven wrote much of his finest music after he became deaf. The American inventor Thomas Edison, perhaps the greatest inventor in history, was deaf much of his life. Franklin D. Roosevelt, paralyzed in both legs by polio at the age of 39, became president of the United States. Helen Keller became blind, deaf, and mute before she was 2 years old, but she learned to read, write, and speak. She devoted her

WORLD BOOK photo



WORLD BOOK photo by Paul S. Conklin

People with disabilities can lead complete lives in spite of their impairments. A woman who uses a wheelchair, *left,* holds a responsible office job. Football players at a college for the deaf, *above,* practice to the low-frequency beat of a drum. Before each play, the members of the offensive team agree that the play will begin on a certain beat of the drum.

life to helping the deaf and the blind.

Problems of people with disabilities

A person who has a disability faces special problems. These problems may affect his or her personal life, family life, and community life.

In personal life. A major problem of many people with disabilities is their limited ability to perform ordinary daily activities. For example, a person with only one arm may have trouble getting dressed and undressed. An individual who has a hearing disability may have difficulty using the telephone. Some people with disabilities lack the ability or energy to get around without assistance.

Disabled individuals also may experience special psychological problems. They may become depressed because their disability makes them different from most other people. However, some people with disabilities think of their disability as a challenge, and this attitude helps them overcome it.

Social relationships can be difficult for people with disabilities. Many nondisabled people do not like to be reminded that disabilities exist. As a result, they may feel uncomfortable in the presence of a person with disabilities. One of the most important things a person with disabilities must learn is how to put others at ease.

In family life. A family's home life may change considerably if some member becomes disabled. Previously, various members of the family had filled certain roles in the household, and difficulties can arise if these roles change. For example, adjustment problems may occur if a parent who provides all or much of the family's income suffers a stroke and no longer can do so. Severe depression could result if the other parent must get a job or take a second job and act as head of the family. In addition, the children may have trouble ac-

Aids for people with disabilities

People with disabilities may require special aids to perform everyday activities. Many public buildings provide structural aids that give people with disabilities access to certain facilities. Various aids also enable people with disabilities to enjoy television and other conveniences.

The wheelchair symbol, *above,* appears on signs marking special facilities for the disabled. Such facilities include ramps that enable wheelchair users to enter and leave a building alone.

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Braille numbers in elevators make it easy for a blind person to quickly locate the button for a certain floor.

© Peter Gonzalez

Captioned television programs enable people who are deaf to enjoy TV as completely as possible. Printed dialogue appears on the screen during such programs.

© L. Perkins

A low telephone enables people in wheelchairs to make calls easily. Other aids for wheelchair users include low drinking fountains and toilets in wide stalls.

cepting the new roles of their parents in the household.

Other members of a family should not try to do too much for the disabled member. People with physical disabilities need to feel independent and should be allowed to solve their own problems whenever possible. If a person with disabilities is overprotected or given extra attention, other family members may feel jealous and resentful. The other family members should let the disabled member know they realize he or she has hopes, goals, and ambitions, just as they have.

In community life, the ignorance of most individuals creates problems for people with disabilities. The majority of people do not realize how much a person with disabilities can achieve. As a result, they may exclude a person with disabilities from community activities, such as athletic events and theatrical productions.

Some employers hesitate to hire a person with disabilities because they believe people with disabilities are poor workers. Actually, work records show that people with disabilities produce as well as or better than other people in the same job. The records show that people with disabilities also hold their jobs longer.

Because of their limited ability to move around, many people with disabilities may lack access to certain places and facilities. At school, for example, a student or teacher in a wheelchair needs ramps instead of stairs, toilets with wide stalls, and other structural aids. Since the 1970's, such aids have been provided in increasing numbers of public buildings. However, accessibility in housing and public transportation remains a serious problem for people with certain disabilities.

Overcoming disabilities

Few disabilities can be cured. Consequently, most people with disabilities must learn to live with their disability. To overcome a disability, an individual must possess a desire to be independent. Without this desire, the help of others has little value and the degree of disability remains high.

Many types of professional assistance are available to help people with disabilities conquer their disability. There are three vital areas in which experts can provide help: (1) rehabilitation medicine, (2) special education, and (3) vocational training.

Rehabilitation medicine is a branch of medicine that helps improve the condition of people with disabilities. In most cases, rehabilitation is carried out in a hospital by a team of specialists headed by a *physiatrist.* Physiatrists are doctors who have been specially trained in physical medicine and rehabilitation. Other members of the team may include nurses, psychologists, social workers, speech pathologists, and other therapists.

The treatment used in rehabilitation depends on the patient's disability. Surgery can help certain kinds of blindness, deafness, and deformities. Drugs may be used to treat severe depression and other mental illnesses. Many people with disabilities benefit from *physical therapy,* which involves treatment by such means as heat, light, and water. Physical therapy may also include special exercises that restore the patient's endurance and muscle strength.

A form of treatment called *occupational therapy* helps overcome or reduce disabilities by teaching patients various skills. These skills help people with disabilities gain confidence in their ability to live a full and normal life. For example, a person who has lost both legs may learn how to drive a specially equipped car.

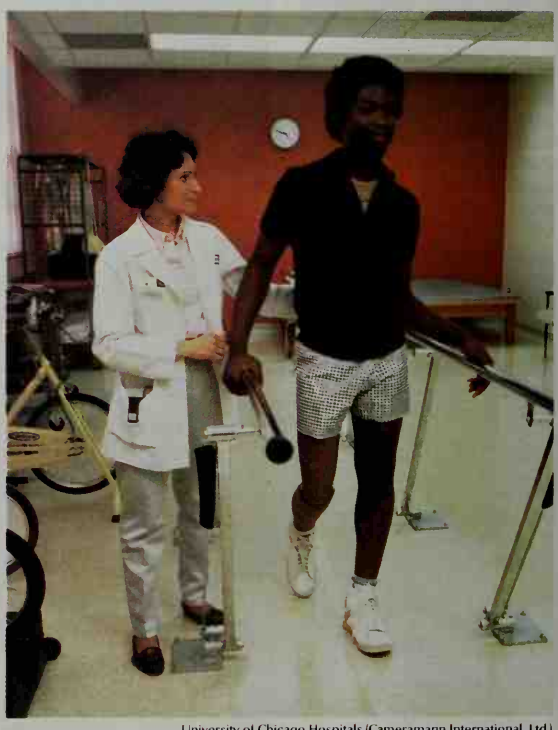
Various mechanical devices also help people with disabilities lead fuller lives. Paralyzed people can move around in electric wheelchairs. Artificial arms and legs replace lost limbs. Hearing aids greatly improve the hearing of people with certain types of deafness.

Special education is instruction designed to help children with disabilities use their full learning ability. It includes instruction in the classroom, at home, and in hospitals and specialized institutions.

Teaching children with disabilities requires special skills and materials. A specially trained teacher may be needed to teach children with mental retardation to care for themselves and to instruct them in basic school subjects. Partially sighted children may require books with large print. Blind children learn through braille books and *talking books* (recordings on records or tapes).

The United States government requires the states to make special education services available to all children with disabilities of school age. Whenever possible, these services must be offered in regular classrooms so that children with disabilities and nondisabled children can be educated together. This process of integrating children with disabilities into regular school programs is called *mainstreaming.* Special classrooms or separate schools are provided only if the severity of a child's disability makes the mainstreaming process impossible.

Vocational training prepares people with disabilities to hold a job. Specialists called *vocational coun-*



University of Chicago Hospitals (Cameramann International, Ltd.)

Rehabilitation of a person with disabilities includes therapy that helps the individual learn or regain various skills. The young man shown here is learning to walk with an artificial leg.

© Dan McCoy, Rainbow

Special education helps children with disabilities use their full learning ability. In this picture, children with mental retardation are working with computerized learning devices.

selors know what type of skills a person needs to succeed in a particular job. These experts conduct tests to determine the abilities and interests of a person with disabilities. After a vocational counselor decides what kind of work might be best, the person can be trained for that work. A blind person may be taught to devise programs for computers. A person who uses a wheelchair may be trained to hold an administrative job.

Attitudes toward people with disabilities

In ancient times, hardly anyone helped people with disabilities. The welfare of a group depended on the ability of each member to fight and to work. People with disabilities who could not fulfill their responsibilities threatened the safety of all, and many were driven away and left to die. Most ancient peoples believed that evil spirits caused injury or disease, and so they felt little compassion for people with disabilities. The Spartans let deformed newborns die of exposure. In Rome, a disfigured infant could be legally drowned by the parents.

During the Middle Ages, from about the A.D. 400's to the late 1400's, people ridiculed people with disabilities and regarded them with suspicion. Some nobles used people with physical disabilities as court jesters. Many people with disabilities were burned as witches.

Attitudes toward people with disabilities began to change in the 1800's. Many people began to pity people with disabilities and treated them with special care. Still, people with disabilities were thought to bring shame on themselves and their families. Most people with disabilities were kept hidden away at home or institutions.

In the mid-1900's, important advances were made in the treatment of people with disabilities. Until that time, many who became paralyzed below the waist died due to urinary problems. But in the 1940's, the discovery of certain antibiotics enabled physicians to keep these patients alive. Modern rehabilitation techniques were developed to help such people lead full, productive lives.

During World War II (1939-1945) and after the war ended, extensive efforts were made to rehabilitate disabled veterans. Military hospitals established rehabilitation centers, and soon many other hospitals also set up these facilities to help disabled people.

During the late 1900's, the U.S. Congress passed three important laws to help people with disabilities. The Rehabilitation Act of 1973 prohibits unfair treatment of disabled individuals in programs or activities that receive government funds. The act also requires many federally funded businesses to make an effort to hire qualified people with disabilities. The Education for All Handi-

© Bernard Pierre Wolff, Photo Researchers

Speech therapy helps many people with disabilities improve their ability to talk. An audio-therapy unit amplifies the voice of a therapist working with children who have a severe hearing loss.

© Larry Day

Vocational training prepares people with disabilities for an occupation. The man in the wheelchair is learning computer skills designed to help him find employment.

Some organizations that help people with disabilities

United States government agencies

Clearinghouse on Disability Information
Washington, DC 20202-2524
http://www.ninds.nih.gov/patients/feds/codi.htm
Informs the public of federal laws and programs related to disabilities. Provides information about services available to disabled people.

President's Committee on Employment of People with Disabilities
Washington, DC 20004-1107
http://www50.pcepd.gov/pcepd/ztextver/welcome.html
Encourages employers to hire disabled workers.

Rehabilitation Services Administration
Washington, DC 20202-2531
http://www.ed.gov
Administers the Education for All Handicapped Children Act, the Rehabilitation Act of 1973, and the Americans with Disabilities Act.

U.S. Employment Service
Washington, DC 20210
http://www.doleta.gov/uses/index.htm
Helps disabled people search for jobs.

U.S. Health Resources and Services Administration
http://www.hrsa.dhhs.gov/default.htm
Administers the block grant that provides funds for state services to disabled children.

U.S. Social Security Administration
Baltimore, MD 21235
http://www.ssa.gov
Administers Supplemental Security Income programs.

Department of Veterans Affairs
Washington, DC 20420
http://www.va.gov
Administers vocational programs for disabled veterans.

Nongovernment organizations

American Foundation for the Blind
11 Pennsylvania Plaza, New York, NY 10001
http://www.afb.org
Serves as a national resource and information center for agencies that help blind people.

Arc, The
500 E. Border St., Arlington, TX 76010
http://www.thearc.org
Promotes research on mental retardation and works for improved treatment and social acceptance of retarded people

Disabled Sports USA
451 Hungerford Dr., Rockville, MD 20850
http://www.dsusa.org
Encourages people with disabilities to participate in sports and other recreational activities.

Goodwill Industries International
9200 Rockville Pike, Bethesda, MD 20814
http://www.goodwill.org
Local agencies provide disabled people with job training, employment, and counseling.

March of Dimes Birth Defects Foundation
1275 Mamaroneck Ave., White Plains, NY 10605
http://www.modimes.org
Supports research on prevention of birth defects and works to improve maternal and newborn health.

National Association of the Deaf
814 Thayer Ave., Silver Spring, MD 20910
http://www.nad.org
Works to improve educational programs and job opportunities for deaf people. Promotes legislation to benefit deaf people.

National Easter Seal Society
230 W. Monroe St., Chicago, IL 60606
http://www.easter-seals.org
Provides services to people with disabilities.

National Federation of the Blind
1800 Johnson St., Baltimore, MD 21230
http://www.nfb.org
Works to improve social conditions for blind people.

National Organization on Disability
910 16th St. NW, Washington, DC 20006
http://www.nod.org
Works to remove physical, social, and legal barriers that discriminate against disabled people.

United Cerebral Palsy Associations
1600 L St. NW, Washington, DC 20036
http://www.ucpa.org
Supports research and provides vocational training for people with cerebral palsy, and sponsors professional and public education about the disease.

capped Children Act of 1975 orders the states to provide a free education for any disabled child who is of school age. Canada has a similar law. The Americans with Disabilities Act of 1990 protects disabled people from discrimination by private employers. It requires that public buildings and mass transportation be accessible to disabled people. The act also orders telephone companies to provide telephone relay services that allow people with speech or hearing impairments to make and receive calls. Henry B. Betts

Related articles in *World Book* include:

Famous disabled people

Beethoven, Ludwig van
Braille, Louis
Bridgman, Laura D.
Browning, Elizabeth Barrett
Charles, Ray
Edison, Thomas A.
Goya, Francisco
Hawking, Stephen W.
Keller, Helen A.
Milton, John
Perlman, Itzhak
Roosevelt, Franklin D.
Toulouse-Lautrec, Henri de
Wonder, Stevie

Other related articles

Affirmative action
Artificial limb
Bell, Alexander Graham
Blindness
Braille
Cerebral palsy
Deafness
Dog guide
Gallaudet University
Goodwill Industries
Hearing aid
Interior design (picture: Access for the disabled)
Lip reading
March of Dimes Birth Defects Foundation
Mental illness
Mental retardation
Muscular dystrophy
Occupational therapy
Physical therapy
Prosthetics
Quota International

Spastic paralysis
Special education
Speech therapy
Vocational rehabilitation

Additional resources

Kent, Deborah. *The Disability Rights Movement.* Children's Pr., 1996. Younger readers.
Kriegsman, Kay H., and others. *Taking Charge: Teenagers Talk About Life and Physical Disabilities.* Woodbine Hse., 1992.
McHugh, Mary. *Special Siblings: Growing up with Someone with a Disability.* Hyperion, 1999.
Potok, Andrew. *A Matter of Dignity: Changing the World of the Disabled.* Bantam, 2002.

Disabled American Veterans (D.A.V.) is an organization of men and women who have been disabled in the line of duty during time of war. It was founded in March 1920 by a group of disabled veterans led by Judge Robert S. Marx of Cincinnati, Ohio.

The purpose of the organization is to care for disabled veterans and to help them return to a useful way of living. Money for rehabilitation work comes from three yearly campaigns in which the D.A.V. sends out millions of requests for contributions.

The D.A.V. has more than 1 million members in over 2,500 chapters in the United States and other countries. Headquarters of the Disabled American Veterans are in Cincinnati. Critically reviewed by the Disabled American Veterans

Disarmament. See Arms control.

Disaster is a sudden, extremely unfortunate event that affects many people. Disasters have included natural occurrences, such as earthquakes and floods, as well as accidents involving airplanes and ships. Some of the major disasters are listed in the table on this page.

Related articles in *World Book* include:

Earthquake
Federal Emergency Management Agency
Flood
Hurricane (table)
Red Cross
Shipwreck
Tornado
Tsunami
Volcano (table)

Discharge, Military. See Military discharge.

Disciple. See Apostles.

Disciples of Christ is a Protestant denomination in the United States. Its full name is the Christian Church (Disciples of Christ). The church observes two ordinances—Communion, or the Lord's Supper; and baptism. Communion is observed every Sunday as the central part of the worship service. The standard form of baptism is by *immersion* (submerging a person in water) for adults. But most congregations of the church accept into membership people baptized by other forms.

The denomination developed during the early 1800's. Its founders included three men of Presbyterian background—Thomas Campbell and his son Alexander in Pennsylvania and Barton W. Stone in Kentucky. Today, the church has about 1million members. Its headquarters are in Indianapolis.

Critically reviewed by the Disciples of Christ

Discount is a term applied in business to a deduction from a stated price or from a payment due at some future date. The discounts most commonly used include *bank discount, trade discount,* and *cash discount.*

Major disasters

Year	Location	Dead	Type of disaster
64	Rome	Unknown	City fire
365	Crete	50,000	Earthquake
856	Iran	200,000	Earthquake
893	India; Iran	330,000	Earthquake
1138	Egypt; Syria	330,000	Earthquake
1201	Northern Egypt	1,100,000	Earthquake
1268	Cilicia (now Turkey)	60,000	Earthquake
1290	Northeastern China	100,000	Earthquake
1556	Central China	830,000	Earthquake
1667	Caucasus (now Azerbaijan)	80,000	Earthquake
1669	Sicily	20,000	Mount Etna eruption
1693	Sicily	100,000	Earthquake
1703	Honshu, Japan	200,000	Earthquake
1730	Hokkaido, Japan	137,000	Earthquake
1731	Beijing, China	100,000	Earthquake
1737	Calcutta, India	300,000	Earthquake; tornado
1755	Lisbon, Portugal	60,000	Earthquake
1779	Northern Iran	100,000	Earthquake
1783	Southern Italy	50,000	Earthquake
1815	Sumbawa, Indonesia	92,000	Mount Tambora eruption
1865	Mississippi River	1,653	Ship explosion
1868	Ecuador	70,000	Earthquake
1883	Southwestern Indonesia	36,000	Krakatau eruption; tsunamis
1887	Eastern China	900,000	Huang He River flood
1900	Galveston, TX	6,000	Hurricane; storm tide
1902	Martinique	38,000	Mount Pelée eruption
1908	Sicily	75,000	Earthquake
1912	North Atlantic	1,500	Sinking of *Titanic*
1915	Central Italy	29,970	Earthquake
1917	Halifax, NS	1,635	Ship explosion
1920	Central China	200,000	Earthquake
1923	Tokyo-Yokohama	142,800	Earthquake; fire; tsunamis
1927	Central China	200,000	Earthquake
1932	Central China	70,000	Earthquake
1935	Western India (now Pakistan)	60,000	Earthquake
1939	Central Chile	30,000	Earthquake
1960	Western Morocco	12,000	Earthquake
1962	Northwestern Iran	10,000	Earthquake
1963	Cuba; Haiti	7,200	Hurricane (Flora)
1968	Northeastern Iran	11,600	Earthquake
1970	Western Peru	66,800	Earthquake; landslide
1970	East Pakistan (now Bangladesh)	266,000	Cyclone; tsunami
1976	Guatemala	23,000	Earthquake
1976	Northeastern China	240,000	Earthquake
1977	Canary Islands	583	Airplane collision
1977	Southern India	15,000	Cyclone; tsunami
1978	Eastern Iran	15,000	Earthquake
1980	Northern Algeria	5,000	Earthquake
1984	Bhopal, India	2,800	Poisonous gas leak
1985	Southern Bangladesh	10,000	Cyclone; tsunami
1985	Central Japan	520	Airplane crash
1985	Central Mexico	7,200	Two earthquakes
1985	Western Colombia	25,000	Nevado del Ruiz eruption; mudslide
1987	Philippines	1,840	Ship collision; fire
1988	Armenia	25,000	Earthquake
1990	Northwestern Iran	40,000	Earthquake
1991	Southern Bangladesh	138,000	Cyclone; tsunami
1993	Central India	9,750	Earthquake
1995	Japan	5,500	Earthquake
1998	Central America	11,000	Hurricane (Mitch)
1999	Northwestern Turkey	17,000	Earthquake
1999	Eastern India	9,615	Cyclone
1999	Venezuela	30,000	Mudslide
2001	Western India	20,000	Earthquake

Sources: foreign governments; U.S. National Geophysical Data Center.

Bank discount is the deduction that a bank makes from the face value of a note. The bank does this when it cashes a note before it is due. Bank discount is determined in the same manner as simple interest. But it is taken in advance, by being deducted from the face value of the note. The difference between the face value of the note and the discount is called the *proceeds.* For example, the holder of a note may wish to turn it into cash, or have it *discounted,* before it becomes due. This may be done by presenting the note to the bank and receiving for it the amount of its face value, less the interest due during the term of discount. The *term of discount,* or *time to run,* is the period of time following the day the note is presented for payment through the day on which it matures. Bank discount creates a higher effective rate of interest than simple interest. The borrower pays the same amount in either case for the use of the money received. But with bank discount, the borrower receives only the proceeds instead of the face value of the note. Suppose a note for $5,000, dated February 26 and maturing on May 26, were presented to the bank on April 1. The number of days following April 1 through May 26 is 55. If the note bears interest at 12 per cent a year, the interest for this 55-day period would be $91.67 (based on a 360-day year). The bank *deducts* (discounts) this sum from the face value of the note as its charge. Then the bank pays the balance, or $4,908.33, to the person who presents the note for payment. The bank collects the full sum of $5,000 on the date the note matures.

Trade discount is a term used by manufacturers and wholesale merchants when they take off a certain percentage of the price given in a price list. This price is called the *list price.* The list price less the discount is known as the *net price.* Market values may change after price lists are issued. Changes in list prices are often made by varying the trade discount.

Cash discount is a deduction of a percentage of a bill for goods sold on credit. A cash discount is given when the bill is paid within a specific period of time. Such a discount might be expressed as *2/10, n/30,* which is read as *two ten, net thirty.* This means that the buyer may deduct 2 per cent from the bill if it is paid within 10 days, or may wait and pay the whole amount at the end of 30 days. Cash discounts may be used to increase the demand for a product or to speed up the collection of bills. Joanna H. Frodin

Discount store is a type of store that sells goods to consumers at relatively low prices. To be a discount store, a store must also have sales of at least $500,000 a year and occupy an area of at least 10,000 square feet (900 square meters). Discount stores carry such merchandise as appliances, clothing, and health and beauty aids. Discount stores became an important retail institution during the 1940's. Today, there are more than 8,500 such stores in the United States. William H. Bolen

Discovery. See **Exploration; Invention.**

Discrimination. See **Segregation; Gray Panthers.**

Discus throw is one of the oldest individual sports. It was a popular event with the ancient Greeks in their Olympic Games. The Greeks considered the discus-throwing champion the greatest athlete.

Athletes in ancient times threw a discus that was made of stone or metal. Today's discus is a round plate of wood or other material. It is tapered at the edge and has a smooth metal rim. A men's discus is 219 to 221 millimeters ($8\frac{5}{8}$ to $8\frac{7}{10}$ inches) in diameter and 44 to 46 millimeters ($1\frac{3}{4}$ to $1\frac{13}{16}$ inches) thick at the center. It weighs at least 2 kilograms (4 pounds $6\frac{1}{2}$ ounces). A women's discus is 180 to 182 millimeters (7 to $7\frac{1}{6}$ inches) in diameter and 37 to 39 millimeters ($1\frac{7}{16}$ to $1\frac{9}{16}$ inches) thick at the center. It weighs at least 1 kilogram (2 pounds $3\frac{1}{4}$ ounces).

Athletes throw the discus from a circle 2.5 meters (8 feet $2\frac{1}{2}$ inches) in diameter. The discus thrower holds the discus in the palm of one hand, the ends of the fingers curling around the rim. He or she whirls in a complete turn to gather speed and power, and hurls the discus at the end of another half turn. The fingertips spin the discus as it leaves the athlete's hand, and the discus flies through the air in a fairly flat position.

A throw does not count if the thrower steps on the circle or touches the ground outside the circle before the discus strikes the ground. Judges measure the throw from the inside edge of the circle to the nearest point the discus struck the ground. Under international rules, each athlete gets six throws if eight or fewer contestants enter the competition. If more than eight athletes compete, each one gets three throws. The eight with the longest throws qualify for the finals, where each of the eight gets three more throws. Michael Takaha

For discus-throwing championship figures, see the tables with **Track and field** and **Olympic Games.**

How to throw a discus

The discus thrower stands in a circle measuring 2.5 meters (8 feet $2\frac{1}{2}$ inches) in diameter. He must not step outside this circle. He holds the discus flat against the palm of his hand, and swings within the circle with his arm outstretched. He releases the discus at the end of $1\frac{1}{2}$ turns. The power comes from his body and the follow-through of his arm.

WORLD BOOK illustration by Nathan A. Greene

© Ron Giling, Panos Pictures

Infectious diseases—such as AIDS in this African patient—have caused much death, disability, and suffering throughout history.

© Joseph Lynch, Medical Images

Noninfectious diseases—such as this patient's kidney ailment—have replaced many infectious diseases as top causes of death.

Disease

Disease is a disorder of the body or the mind. Diseases affect almost all forms of life, including animals, plants, and one-celled organisms. In people and other animals, diseases are a major cause of suffering, disability, and death. Plant diseases destroy crops, reduce harvests, and ruin gardens. This article discusses human diseases.

Human diseases may occur as sudden illnesses, as long-term disabilities, or as an unavoidable result of aging. All people experience diseases at some time in their lives, but individuals vary greatly in their likelihood of getting any particular disease. This variation is due to many factors, including age, environment, heredity, social conditions, stress, and a person's general health.

Genes are one of the most important factors that influence health. *Genes* are chemical instructions that control how living things grow, develop, and function. Every human cell contains 30,000 to 40,000 genes. Genetic instructions are so complicated that many mistakes can occur. Many of these errors can lead to diseases.

Attitudes about health also play an important role in disease. People can make many choices that help maintain health, including not smoking, exercising regularly, and eating a balanced diet. Stress, depression, and other emotional states can influence who becomes ill, how sick they feel, and how quickly they recover.

Ideas about health and sickness differ from one culture to another. In developed countries, many people who fall ill with colds or other minor illnesses stay home from school or work. They may seek a doctor's attention and expect to receive drugs or other treatments. But in less developed nations, sick people may continue to work and meet other demands of daily life unless an illness completely disables them.

Diseases have existed since life began. Scientists have examined 2,000-year-old Egyptian mummies and found evidence of many of the same diseases that trouble people today. But diseases have also changed over time.

For most of human history, infectious diseases, such as plague, smallpox, and pneumonia, were the main cause of death and disability. In some cases, these diseases affected the course of history. For example, many historians think that smallpox was one factor that helped Spanish explorers conquer Indian civilizations of the Americas during the 1500's. Smallpox did not exist in these civilizations until the Spanish unintentionally carried it with them from Europe. The disease swept through the Native American populations, making it easier for the Spanish to subdue them.

The first important advance against infectious diseases occurred in 1796, when British physician Edward Jenner developed the first vaccine—a vaccine against smallpox. During the 1800's, doctors began to under-

Mark W. Stolar, the contributor of this article, is Associate Professor of Medicine at Northwestern University Medical School.

stand the importance of cleanliness and antiseptics in preventing the spread of infections. Widespread use of antibiotics during World War II (1939-1945) was another important milestone in progress against infectious diseases. In the years following their introduction, antibiotics were commonly known as "wonder drugs" because their effect on serious infections was so dramatic.

In 1980, the World Health Organization announced that smallpox had been eliminated from the earth. But other infectious diseases continue to create problems. In some cases, the microorganisms that cause these diseases have developed the ability to resist the effects of antibiotics. Infections that become resistant to antibiotics may pose a renewed threat to world health.

As vaccines, antiseptics, and antibiotics helped people survive infectious diseases, life expectancy increased. Improved public sanitation and better standards of living also helped extend the average life span. According to the World Health Organization, most people in the mid-1900's did not live past the age of 50. Today, worldwide average life expectancy is about 65 years, and many people live even longer. Extended life has brought new importance to the diseases of aging. In many countries, most death and disability are now due to such ailments as arthritis, cancer, heart disease, and osteoporosis.

Changes in the way people live have also affected worldwide patterns of disease. For example, high-speed international travel provides a means for disease to spread much more quickly than in the past. Doctors first

Some communicable diseases

Disease	Symptoms	Incubation period*	Period of communicability	Preventive measures
AIDS	Opportunistic illnesses (disorders that usually do not occur when the immune system functions properly).	Averages 8 to 11 years. Specific cases vary widely.	Immediately after infection and as long as virus remains in body.	Avoid sexual contact with infected individuals. Avoid sharing hypodermic needles.
Chickenpox	Small blisters that form crusts, fever, headache, general discomfort.	11 to 20 days.	From 1 to 2 days before symptoms appear until 6 days after first rashes form.	Chickenpox vaccine. Getting the illness gives immunity.
Chlamydia	In men, painful urination and discharge from the penis. In some women, vaginal discharge. Many women have no symptoms. In infants, causes pneumonia or conjunctivitis.	In adults, 1 to 3 weeks. In infants, conjunctivitis may develop in the first 10 days of life. Pneumonia may develop 3 to 6 weeks after birth.	In adults, about 16 months. Unknown for infants.	Avoid sexual contact with infected individuals.
Hepatitis B	Weakness, loss of appetite, nausea, enlarged and tender liver, jaundice.	Averages 12 to 14 weeks; ranges from 6 weeks to 6 months	Usually about 2 months; may be lifelong.	Childhood immunization.
Influenza	Fever, chills, muscular aches and pains.	1 to 5 days.	When symptoms appear until 7 days after.	Influenza immunization protects for only a few months.
Measles	Fever, runny nose, cough, red and watery eyes, rash.	8 to 12 days.	From 4 days before rash appears until 5 days after.	Measles immunization at 15 months of age and repeated during childhood or adolescence.
Mononucleosis	Sore throat, fever, enlarged lymph glands, fatigue.	4 to 6 weeks.	Up to months following infection; may be lifelong.	None.
Mumps	Chills, headache, fever, swollen glands in neck and throat.	12 to 25 days; usually 18 days.	From 7 days before until 9 days after symptoms, or until swelling disappears.	Mumps immunization. Gamma globulin protects after exposure.
Poliomyelitis	Fever, sore throat, muscle pain, stiff back, paralysis.	Paralytic, 7 to 14 days. Nonparalytic, 4 to 10 days.	Last part of incubation period and first week of acute illness.	Poliomyelitis vaccine given at 2 months of age and repeated throughout childhood.
Rubella	Headache, enlarged lymph nodes, cough, sore throat, rash.	14 to 21 days, usually 18 days.	From about 7 days before rash appears until about 5 days after.	Rubella immunization. Getting the illness gives permanent immunity.
Syphilis	Chancre sore, usually on sex organs; followed in a week to 6 months by a rash.	10 days to 3 months, usually 3 weeks.	Variable and indefinite during 2 to 4 years after infection.	Avoid sexual contact with infected individuals.
Tuberculosis	Fever, loss of appetite, weight loss, cough.	Varies from weeks to years.	As long as infection is active.	Screen for infection with skin test; isolate and treat infected individuals.

*Incubation period refers to how long it takes for the first symptoms to appear after infection.
Each of the diseases listed on this table has a separate article in *World Book*.

recognized AIDS as a "new" disease in the United States during the early 1980's. Within a decade, AIDS had become a global epidemic.

Scientists recognized additional new diseases during the late 1900's. A virus called *rotavirus,* first identified in the early 1970's, is one of the chief worldwide causes of diarrhea in children. Other newly recognized diseases include a type of pneumonia called Legionnaires' disease and Lyme disease, an infection transmitted by ticks.

Experts around the world work constantly to understand how diseases change and how these changes may affect human health. Researchers study patterns of infections, population shifts, and social changes. They explore new insights into such matters as the role of genes, the influence of the environment, and the effects of aging. With these efforts, scientists hope to preserve past gains over disease and ensure future successes.

Infectious diseases

Infectious diseases, also called *infections,* occur when an organism or other agent gains entry to the body and reproduces itself. Infectious agents are also called *pathogens* (pronounced *PATH uh juhnz*) or, commonly, *germs.* Some pathogens damage or destroy the cells or tissues in which they reproduce. Others produce toxic chemicals that harm the body. In some cases, the body's response to infection damages its own tissues.

Infectious diseases can be grouped according to the type of agent that causes them. Bacteria and viruses are the most common pathogens. Other pathogens include fungi, protozoans, and worms.

Bacterial diseases. Bacteria are microscopic, one-celled organisms that rank among the most widespread of all living things. Enormous numbers of bacteria live almost everywhere in the world. A small sample of soil may contain millions of these microorganisms.

Most bacteria do not cause disease. Many kinds—called *resident bacteria*—live harmlessly on the skin or in the human mouth and intestines. These resident bacteria help protect people by crowding out or killing many disease-causing bacteria. Resident bacteria seldom cause disease unless they move to an organ where they are not normally present. For example, bacteria that live harmlessly in the mouth can cause infection if they enter the bloodstream and begin growing on a damaged heart valve.

Most bacterial diseases result when bacteria multiply rapidly in living tissue. As they multiply, the bacteria release substances called *enzymes* that cause inflammation and damage or destroy living tissue. The body's response to invading bacteria also contributes to inflammation. This inflammation causes many of the familiar symptoms of disease, including cough, diarrhea, discharge, and pain.

For example, the redness and pus of pimples occur when a weak bacterium called *Propionibacterium acnes (PROH pih AHN uh bak TIHR ee uhm AK neez)* multiplies in the oil glands of the skin. A bacterium called *Mycobacterium tuberculosis (MY koh bak TIHR ee uhm too BUR kyuh LOH sihs)* can multiply in the lungs and cause the cough associated with tuberculosis. The bacterium *Chlamydia trachomatis (kluh MIHD ee uh truh KAHM uh tuhs)* causes a sexually transmitted disease that is commonly called *chlamydia.* Symptoms of chlamydia may include sore throat, pneumonia, painful urination, discharge from the sex organs, and blindness.

Some bacteria cause disease by producing poisonous substances called *toxins.* One such disease is *tetanus (TEHT uh nuhs).* Tetanus is caused by the bacterium *Clostridium tetani (klahs TRIHD ee uhm TEHT uh ny),* which normally lives in soil. If it enters the body through a wound, the bacterium makes a toxin that causes violent muscle contractions. A bacterium called *Clostridium botulinum (klahs TRIHD ee uhm BAHCH uh lihn uhm)* can multiply in food and produce a deadly toxin. This toxin causes *botulism (BAHCH uh lihz ihm),* a type of food poisoning that paralyzes muscles throughout the body.

Viral diseases. Viruses are even smaller than bacteria—scientists can see them only with powerful electron microscopes. Viruses cannot multiply except within the cells of other living things. Once viruses gain entry to living cells, they take over the cells' own reproductive machinery to produce more viruses. As viruses multiply, they damage or destroy cells. The dying cells release greater numbers of viruses, which then move on to infect other cells. If the body's defenses cannot stop this viral multiplication, disease results.

Some of the most familiar diseases—including influenza and the common cold—are caused by viruses. Viruses also cause chickenpox, measles, mumps, and rubella (also called German measles). Most cases of diarrhea and vomiting result from viral infections.

Such serious diseases as hepatitis, polio, rabies, and AIDS are also caused by viruses. HIV, the virus that causes AIDS, reproduces within certain cells of the immune system and weakens the body's ability to resist diseases. As a result, people with AIDS fall ill with diseases that do not normally occur or that are not usually serious. Many people with AIDS die from these illnesses that take advantage of the body's weakened immune system.

Other infectious diseases can be caused by fungi, protozoans, or worms that live in or on the human body. These pathogens cannot make their own food—they obtain nourishment by breaking down body tissues or by absorbing digested food from the intestines. Diseases caused by these pathogens range from minor skin infections to life-threatening disorders.

Most fungi are weak pathogens that are normally present in small numbers on the skin or in the intestines or other organs. Common fungal infections include such skin disorders as athlete's foot and ringworm.

Serious fungal infections are uncommon in otherwise healthy people. People who have other health problems or weakened immune systems, however, may develop fungal infections that spread throughout the body. Some fungi can cause *meningitis (MEHN ihn JY tihs),* an infection of the membranes that line the brain. Fungi also cause a potentially serious disease of the lungs called *histoplasmosis (HIHS tuh plaz MOH sihs).*

Protozoans are another type of one-celled organism. Disease-causing protozoans occur throughout the world. Protozoans called *Plasmodia (plaz MOH dee uh)* cause malaria, which ranks among the greatest worldwide causes of death and suffering. A protozoan called *Toxoplasmosis gondii (tahk suh plaz MOH sihs gond eye)* can be fatal in people whose immune system is weakened by cancer or AIDS. An increasingly common

protozoan called *Giardia lamblia (jih AR dee uh LAM blee uh)* causes severe, long-lasting diarrhea.

Flatworms and roundworms are among the worms that cause human disease. Disease-causing flatworms include flukes, which can invade the blood, intestines, liver, or lungs; and tapeworms, which live in the intestines. Disease-causing roundworms include hookworms and pinworms. Worm infections cause many serious tropical diseases, including elephantiasis *(EHL uh fuhn TY uh sihs)* and river blindness.

Spread of infectious diseases. Infectious diseases vary greatly in how easily they spread among people. An unusually contagious illness that sweeps through a community or an entire continent is called an *epidemic*. An epidemic that travels rapidly from one continent to another is called a *pandemic*. A major pandemic occurred during the winter of 1918-1919, when an outbreak of unusually deadly influenza swept the world. Infectious diseases that are always present in a particular region are called *endemic* to that region. For example, malaria is endemic to the jungles of Asia and Africa.

Some of the important ways that infectious diseases are spread include (1) by people, (2) by animals, (3) by water, (4) by food, and (5) by nonliving sources

By people. Many common diseases travel directly from a person who has the disease to other people. Illnesses that spread by direct person-to-person contact are called *communicable*. Examples of communicable diseases include AIDS, colds, hepatitis, influenza, pneumonia, strep throat, and tuberculosis.

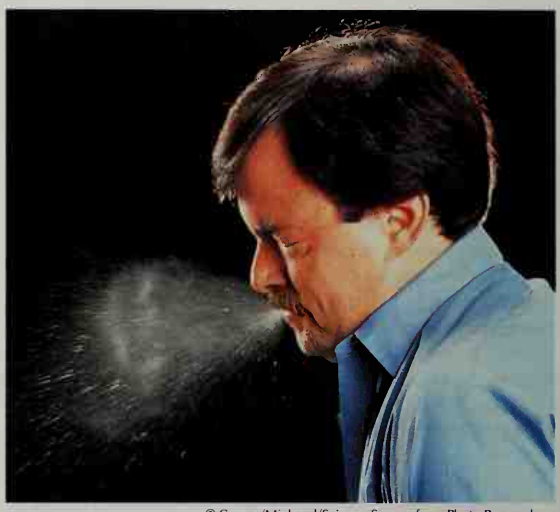
Many infections spread from one person to another on hands. People often catch colds and other viral illnesses when their hands carry the virus to membranes in their eyes or nose. Doctors have known for more than 100 years that thorough hand washing helps prevent the spread of disease. Infections are also spread from person to person by coughs, sneezes, and sexual contact.

By animals. Some infectious diseases are spread by insects and other animals, especially blood-sucking insects, such as mosquitoes and fleas. Mosquitoes rank among the most serious threats to public health. They spread malaria, yellow fever, encephalitis, and other deadly ailments. Fleas carry some types of plague. Before antibiotics, epidemics of plague swept through the world periodically and killed millions of people. Ticks, which are related to spiders, can transmit Lyme disease, Rocky Mountain spotted fever, and other illnesses.

A few infectious diseases are spread by infected birds or mammals. One example is rabies, a virus that can infect bats, cats, dogs, raccoons, skunks, and other mammals. The bite of an infected animal can transmit rabies to people. A disease called *psittacosis (SIHT uh KOH sihs)* or *parrot fever* can pass from infected birds to people.

By water. Dirty drinking water remains a major cause of disease in many parts of the world. Some less developed nations lack the resources to provide citizens with sewerage systems, water purification, or toilet facilities. As a result, human waste enters the drinking water and spreads bacteria, worms, and protozoans. These pathogens cause widespread diarrhea and other intestinal disorders. Outbreaks of diseases carried by water also occur occasionally in developed countries, often when sewage unexpectedly enters community water supplies.

By food. Many foods can nourish pathogens just as effectively as they nourish people. Bacteria, such as E. coli *(EE KOH ly)*, campylobacter *(KAM puh loh BAK tur)*, or salmonella *(SAL muh NEHL uh)*, can grow and reproduce in such foods as chicken, beef, or mayonnaise. Many pathogens transmitted in foods cause vomiting, diarrhea, and other intestinal disturbances.



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A sneeze sends a cloud of virus-laden droplets into the air around a person with a cold. Covering sneezes and coughs can help prevent the spread of colds and other viral diseases.

By nonliving sources. Objects spread less disease than people, animals, food, or water do. But some pathogens survive long enough to pass from person to person on nonliving things. For example, scientists have found that kitchen sponges and dishcloths contain surprisingly large numbers of pathogens. The United States Food and Drug Administration recommends that people sterilize or replace sponges and dishcloths regularly.

Noninfectious diseases

Noninfectious diseases are an extremely broad group of illnesses that are not caused by pathogens. Important categories of noninfectious diseases are (1) inherited diseases, (2) cancer, (3) metabolic diseases, (4) disorders of the immune system, (5) environmental and occupational diseases, and (6) diseases associated with aging.

Inherited diseases involve defects in genes that can be passed from one generation to another. In some cases, the role of such genes is well understood and clearly defined. For example, anyone who inherits the gene for Huntington's disease eventually gets this fatal disorder of the nervous system. Likewise, anyone who inherits the *sickle hemoglobin gene* from both parents develops *sickle cell anemia*, a serious blood disease.

Many other diseases—for example, high blood pressure and heart disease—run in families. But there is no set pattern to how they occur. Scientists suspect that many such conditions involve inherited genes, but the particular defective genes have not yet been identified. In some diseases, researchers think that more than one gene is involved. In other diseases, a gene with an inherited defect must be further damaged by chemicals, viruses, or other factors before it causes an illness.

Some diseases occur because human genes adapt

people to ways of life that no longer exist. For example, bodily processes that occur as a response to stress helped people fight or flee real physical dangers in prehistoric times. People today still have stress reactions, but most of the challenges that modern people face are mental and emotional. Stress is a much less useful response to such challenges than it is to physical threats. In addition, stress places heavy demands on the body. Many doctors estimate that stress is involved in more than half of all illnesses. Ailments in which stress often plays an important role include headaches, chest pains, muscle aches, and stomach upsets.

Cancer is one of the most common and feared diseases throughout the world. It occurs when cells in the body multiply without control. Cancer can begin in almost any type of cell. Cancer cells invade and eventually destroy surrounding normal tissue. In addition, cells from the original cancer can spread and form more cancers in distant parts of the body. If left untreated, most types of cancer are fatal.

Cancer arises from defects in the genes that control cell growth and division. Some people inherit such defective genes. For example, scientists have identified certain inherited abnormal genes that greatly increase the risk that a person will develop breast or colon cancer.

Most people who develop cancer have not inherited genetic defects. Their genes have been damaged after birth by chemicals, radiation, viruses, or other substances in the environment. One of the most common—and most avoidable—causes of cancer is cigarette smoke. Scientists estimate that one-third of all cancers arise from genetic damage due to smoking.

Metabolic diseases result from disturbances in the *metabolism*, the complex system of chemical processes by which the body nourishes, maintains, and regulates itself. These processes control how the body stores and releases the energy needed to grow, to maintain tissues, or to repair them. Metabolic diseases may arise chiefly as a result of poor nutrition or endocrine disorders.

Poor nutrition. Food provides the raw materials needed for metabolism. Important steps in metabolic processes cannot occur if a person's diet lacks enough sugars, proteins, fats, vitamins, or minerals. For example, children who eat too little protein may develop a disease called *kwashiorkor (KWAH shee AWR kawr).* Children with kwashiorkor fail to grow because proteins provide the building blocks for body tissues.

Even when food is plentiful, people may not eat enough of the right foods. People throughout the world commonly take in too little of the mineral calcium, which is needed to keep bones strong. Lack of calcium contributes to a condition called *osteoporosis*, in which bones gradually become thin and brittle as people grow older. Fractures due to osteoporosis are a major cause of suffering and death in elderly people.

In developed countries, many people become overweight by eating too many calories and too much fat. Excess weight puts extra demands on the body and can disturb metabolism. For example, many overweight people have too much fat circulating in their blood. High levels of blood fats increase the risk of heart disease.

Endocrine diseases are caused by malfunctions in the body's system for regulating metabolism. Much of this regulation is accomplished by *hormones*, chemicals that are produced in one part of the body but affect one or more other parts. Most hormones are made in structures called *glands.*

One of the most common endocrine diseases is *diabetes mellitus (DY uh BEE tihs* or *DY uh BEE teez MEHL uh tuhs).* Diabetes is a serious disorder involving the hormone *insulin.* Insulin is produced by the pancreas, which acts as both a gland and a digestive organ. Insulin enables cells to use and store sugar as a source of energy. In some cases of diabetes, the pancreas does not produce enough insulin. In other cases, insulin is produced, but the body's cells resist its effects. Being overweight increases the risk of diabetes because excess weight is one cause of insulin resistance.

Diabetes severely affects cells throughout the body. Cells that cannot use sugar may starve and die. Other cells are damaged by high levels of sugar that build up in the blood. As cellular damage accumulates, diabetes can cause disability and death.

Disorders of the immune system. The immune system consists of cells, molecules, and tissues that work together to defend the body against infections, cancer, and other invaders. In rare cases, children are born with

Types of disease-causing microbes

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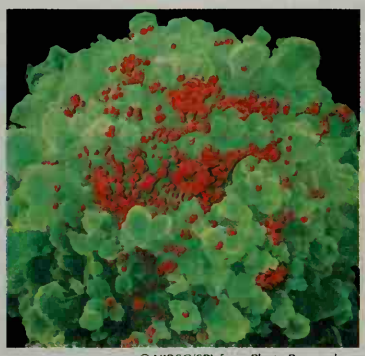
Bacteria, such as these *Streptococcus* cells, cause many diseases, including ear infections, strep throat, and pneumonia.



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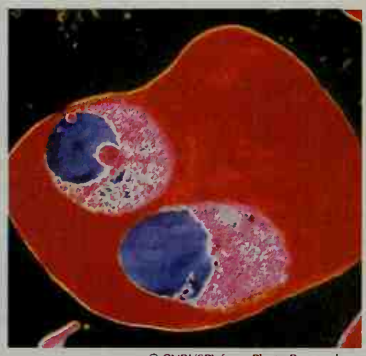
Viruses, such as the human immunodeficiency virus (HIV) shown in red, cause AIDS, polio, and other serious illnesses.



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Protozoans, such as the malaria parasites shown here in pink and blue, cause many painful and disabling diseases.

defective immune systems that cannot defend them properly. Many such children do not survive without special drugs, surgery, or bone marrow transplants.

Most immune disorders occur because of flaws in the immune system's ability to recognize harmful substances. The most common immune disorders are allergies, including asthma, hay fever, and hives. Allergies occur when the immune system reacts to a substance in the environment as if it were a dangerous invader. Common causes of allergies include pollens, molds, animals, house dust, and foods. Allergic reactions can range from a runny nose and itchy eyes to a fatal shutdown of body systems.

Autoimmune diseases are another common immune disorder. In these diseases, the immune system attacks the body's own tissues as if they were foreign invaders. Autoimmune diseases can affect tissues and organs throughout the body. One serious autoimmune disease is *systemic lupus erythematosus (sihs TEHM ihk LOO puhs EHR uh THEHM uh TOH sihs)*, often shortened to SLE. SLE can attack the heart, lungs, skin, nerves, eyes, kidneys, and other organs.

Environmental and occupational diseases. *Environmental diseases* result from substances in the air, water, or other surroundings. Such disorders are called *occupational diseases* when they are caused by factors associated with a particular workplace.

Air pollution is a common environmental cause of disease. Air pollution can irritate the eyes, nose, and throat. Many lung problems, including asthma and infections, are made worse by dirty air. When air pollution reaches extremely high levels, scientists advise people to avoid outdoor activity—especially vigorous exercise.

Noise is another common pollutant in modern life. Prolonged exposure to loud noise can lead to hearing loss. Noise pollution also contributes to development of stress-related illnesses.

People expose themselves to some environmental agents through their own habits. For example, cigarette smokers inhale many chemicals and particles that cause cancer, heart disease, and other ailments. Smokers also endanger the lives of nonsmokers around them. Breathing another person's cigarette smoke raises risk of cancer and heart disease.

The habits of pregnant women affect not only themselves but also their unborn babies. A mother's smoking can hinder her baby's ability to gain weight and cause other health problems. Exposure to drugs or alcohol before birth can also interfere with normal development.

Some occupations expose workers to harmful environments. The mineral asbestos is a well-known cause of occupational disease. Asbestos was once widely used for manufacturing, packaging, insulating, and other purposes. But health problems in people who worked with asbestos gradually revealed the deadly consequences of breathing its fibers. Scientists now know that inhaling asbestos scars the lungs badly. In addition, the mineral causes cancer of the lungs and of the tissues that line the chest and abdomen. Many countries now limit exposure by requiring that asbestos workers wear protective clothing and breathing devices.

Repetitive strain injuries (RSI's) are occupational diseases of growing importance. RSI's are painful disorders caused by performing a similar movement over and over again. A wide range of occupations—from computer programming to meat cutting—pose a risk of RSI's. A wrist disorder called *carpal tunnel syndrome* is the most common such injury. Experts in *ergonomics (UR guh NAHM ihks)* seek ways to prevent these disorders. Ergonomics is the science of designing machines, objects, and physical environments to match the needs and abilities of human beings.

Diseases associated with aging involve gradual breakdown of cells, tissues, and organs as people grow older. No one can avoid all diseases forever, because some disorder eventually causes everyone's body to fail and die. But several factors influence how soon people's bodies begin to show signs of age. Genes have some effect on which diseases people get and on the age when they tend to get them. People can delay or avoid development of some diseases through a balanced diet, exercise, not smoking, and other good health habits.

Cardiovascular diseases, which affect the heart and blood vessels, are a leading cause of death around the world. Some cardiovascular disorders develop and worsen over the course of many years. For example, *atherosclerosis (ATH ur oh skluh ROH sihs)* is a disease in which fatty deposits gradually build up on the inside walls of arteries. The deposits interfere with the flow of blood and can lead to heart attacks and strokes. Almost everyone develops some degree of atherosclerosis as they age. But people can help control atherosclerosis by exercising and limiting the amount of fat they eat.

Hypertension (high blood pressure) is another long-term disorder that contributes to strokes and heart attacks. Blood pressure that is too high increases the heart's workload and puts extra strain on blood vessels. Doctors often call hypertension "the silent killer" because it rarely causes symptoms until after it has caused widespread damage to the heart and blood vessels. But a doctor can easily diagnose high blood pressure with a simple examination. In many cases, drugs or changes in diet can lower the blood pressure to safe levels.

Heart attacks or strokes may strike after years of atherosclerosis or hypertension damage the heart and blood vessels. A heart attack usually occurs because an artery to the heart suddenly becomes blocked. As a result, part of the heart does not receive enough oxygen-rich blood and dies. Many heart attacks—including first attacks—are fatal. But many people also survive attacks that affect only a small portion of the heart. People who have had a heart attack can improve their health and help avoid additional attacks with a cardiac rehabilitation program. Such programs may include a low-fat diet, increased levels of exercise, and drugs to reduce blood fat.

A stroke occurs when part of the brain does not receive enough blood. The affected portion may be permanently damaged. Some strokes are fatal. Others cause various disabilities, depending on the area of the brain that is damaged. Common problems include paralysis and loss of speech. In some cases, undamaged areas of the brain eventually take over some lost functions. But many stroke patients are left with permanent disabilities.

Arthritis is a general term for diseases that affect the joints and muscles. Two widespread forms of arthritis are *rheumatoid arthritis (ROO muh TOYD ahr THRY tihs)* and *osteoarthritis (AHS tee oh ahr THRY tihs)*. Rheumatoid arthritis causes pain and swelling in joints throughout

the body. It can strike people of any age, but it is most common in middle-aged women. The cause of this type of arthritis is not known. Osteoarthritis, the most common form of arthritis, affects millions of older adults. This disorder results from wear and tear on the joints, especially those of the knees, hips, lower back, and fingers. The pain of osteoarthritis forces many older people to limit their movements and activities. Surgical replacement of joints can provide relief in some cases.

Degenerative diseases of the brain are caused by gradual destruction of brain cells. One common condition is *Alzheimer's (AWLTS hy murz) disease*, which chiefly affects people over the age of 60. In Alzheimer's disease, excessive amounts of proteins called *amyloid (AM uh loyd)* build up in brain cells and kill them. As more cells die, people become unable to remember or make judgments. Alzheimer's patients eventually become bedridden and cannot care for themselves. Doctors do not yet know what causes Alzheimer's disease, but many cases appear to involve genetic factors.

Fighting disease

Medical scientists have learned a great deal about how the body defends itself against illness. Two of the chief defenses that the body uses are natural barriers against pathogens and immune responses. Medical treatment helps people overcome a wide range of diseases that the body cannot conquer without help.

Natural barriers are physical or chemical obstacles that prevent pathogens from entering the body. For example, tears wash foreign substances from the eyes and contain proteins that destroy many common pathogens. One of the most effective physical barriers is unbroken skin, which few pathogens can penetrate.

Sheets of tissue called *mucous membranes* form barriers on many internal body surfaces. These membranes are covered with *mucus*, a sticky fluid that catches many pathogens. In addition, mucous membranes release protective chemicals. For example, mucous membranes that line the nose and mouth trap many pathogens. The body then expels the invaders by sneezing or coughing.

Mucous membranes in the breathing tubes, the *bronchi (BRAHNG ky)*, play an important role in protecting the lungs. Most cells in the bronchi have tiny hairlike projections called *cilia (SIHL ee uh)*. Cilia move in coordinated waves that push mucus and trapped pathogens out of the bronchi, up the windpipe, and into the mouth. Mucus that reaches the mouth can then be harmlessly swallowed. When swallowed pathogens reach the stomach, many are destroyed by acid digestive juices.

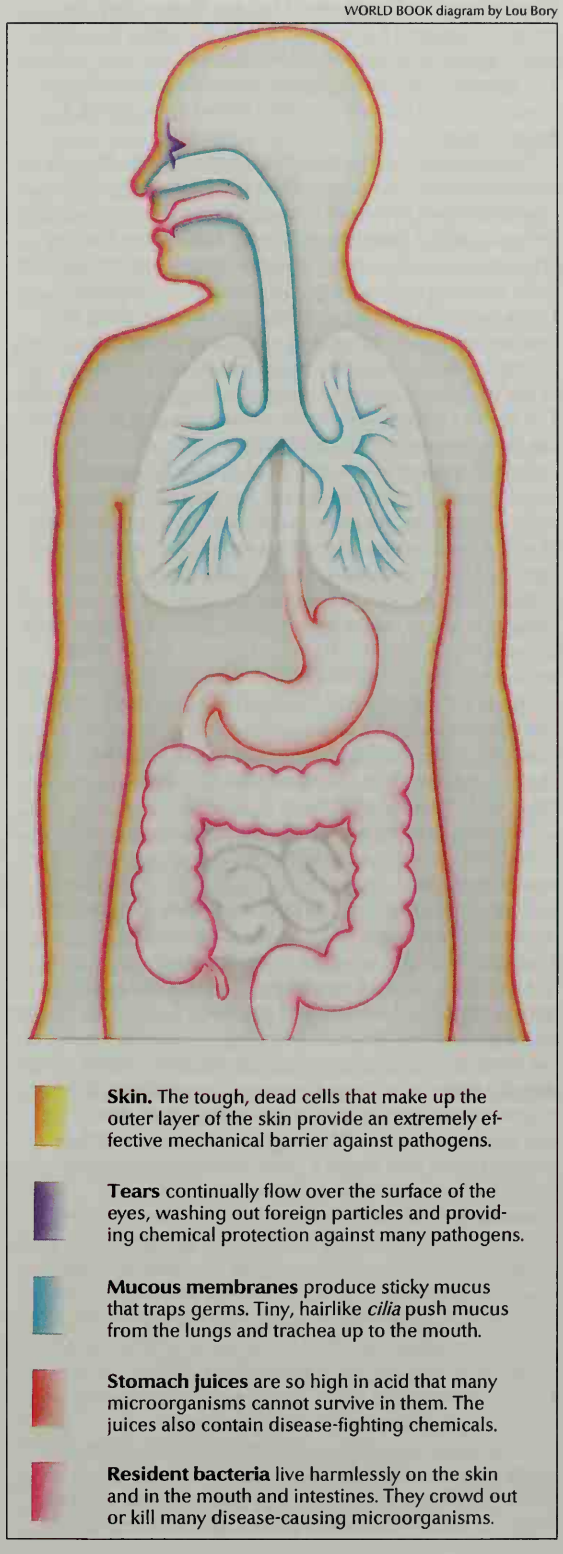
Resident bacteria that live harmlessly on the skin, in the mouth, and in the intestines provide another barrier against disease. They crowd out many pathogens that might otherwise flourish. Resident bacteria also produce substances that kill or damage certain pathogens.

Immune responses defend against pathogens that get past the body's natural barriers. These responses are the body's most powerful weapons against disease. In an immune reaction, cells, molecules, and chemical messengers work together to identify and overcome foreign invaders. The immune system also helps fight cancer cells that develop within the body. People's immune systems differ in effectiveness due to heredity, stress, previous illnesses, and other factors.

Barriers against infections

The body's defenses against infectious diseases include physical and chemical barriers against germs. This diagram shows some of the natural barriers that block disease-causing microbes.

WORLD BOOK diagram by Lou Bory



White blood cells are a key part of the immune system. Certain white blood cells patrol for pathogens as they circulate through the body. One such group of scouts are called *phagocytes (FAG uh sytz).* Their name comes from the Greek word for *eat.* Phagocytes surround and digest bacteria and infected cells, then display fragments of the digested invaders on their surface. The phagocytes then "present" these fragments to another group of patrolling white blood cells called *T-helper cells.*

When phagocytes and T-helper cells meet, they release chemicals that strengthen the immune response. One important group of immune-system chemicals are proteins called *interferons (IHN tur FIHR ahnz).* Interferons are one of the body's chief defenses against viruses. Cells infected with viruses also produce interferons. These proteins hinder viral infections by binding to healthy cells and preventing viruses from entering them.

Some other chemicals signal blood vessels at the site of the immune reaction to begin leaking fluids and cells. The fluids contain additional substances that help fight the invading pathogens and attract more white blood cells. Still other chemicals signal the body to raise its temperature. A fever increases the rate of chemical reactions in the immune system and speeds the movement of white blood cells. Some researchers also think fever directly kills or weakens certain pathogens.

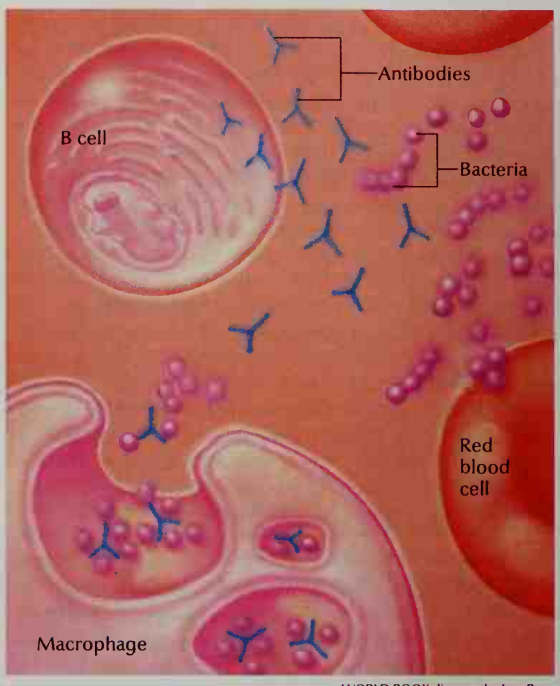
After T-helper cells meet phagocytes, they activate additional types of white blood cells. When T-helper cells activate white blood cells called *B cells,* these cells release proteins called *antibodies.* Antibodies attach themselves to pathogens and toxins. This attachment may either kill the invaders or make them harmless. For example, some antibodies coat bacteria and make them clump together. The clumped bacteria attract phagocytes and are easier for them to digest.

T-helper cells also activate another type of T cell called *cytotoxic (sy tuh TAHK sihk) T cells,* commonly known as *killer T cells.* Killer T cells destroy diseased cells, including cancerous cells and ones infected with viruses. White blood cells called *natural killer cells* are another important weapon against cancer.

After the body has successfully overcome an infection, white blood cells called *memory T cells* and *memory B cells* "remember" the infection. This ability enables the body to develop long-term protection—called *immunity*—to many infectious diseases. For example, the immune system remembers the measles virus after a person has had measles. The next time that virus strikes, memory cells will begin a rapid response that destroys the virus before it causes illness.

Medical treatment. Efforts to treat disease have played an important role in life since ancient times. Early healers knew little about the body and had no understanding of the real causes of illness. Knowledge of the body and its ailments increased gradually over the centuries, then grew rapidly during and after the Renaissance, which lasted from about the 1300's to the 1600's. Today, doctors and other health professionals can offer a vast range of treatments to fight disease.

To provide successful treatment, doctors must correctly *diagnose* (identify) a disease. Accurate diagnosis relies heavily on the skill of a physician because many diseases cause similar symptoms. Doctors first ask patients about their current symptoms and how the symptoms developed. The doctor also inquires about the medical history of the patient and family members. An office examination can reveal much about a patient's basic condition, including body temperature, blood pressure, pulse, and heart and lung sounds.



WORLD BOOK diagram by Lou Bory

An immune reaction involves many different body cells. White blood cells called *B cells* release disease-fighting proteins called *antibodies.* In this illustration, antibodies make invading bacteria clump together. These clumps are then surrounded and destroyed by large white blood cells called *macrophages.*

If an office examination and careful questioning do not clearly indicate a diagnosis, a doctor may order additional tests. For example, blood, urine, and other body fluids can be analyzed for chemical, cellular, or genetic abnormalities. Imaging techniques, such as *computed tomography* (CT) and *magnetic resonance imaging* (MRI), can provide detailed pictures of the inside of the body. These technologies can detect deeply hidden tumors, abnormalities of the brain, and other difficult-to-diagnose conditions. Disorders of the heart can be pinpointed with such techniques as stress testing or imaging with ultrasound or radioactive tracing materials.

After making a diagnosis, a doctor recommends treatment. The simplest treatments involve rest, a healthful diet, and other measures that support the body while it heals itself. In other cases, more extensive treatment is needed to help the body overcome an illness.

Drugs are one of the physician's most important weapons against disease. Antibiotics, which can cure many bacterial infections, are among the most successful drugs ever developed. Some bacteria, however, develop resistance to an antibiotic during a course of treatment. These resistant bacteria then multiply in the body and create an even more serious infection. Doctors strongly caution that antibiotics must be prescribed and

used responsibly. Excessive or inappropriate use of antibiotics creates opportunities for bacteria to develop dangerous resistance.

Many fungal and worm infections can also be treated with drugs. Most viral illnesses, however, cannot be cured with drugs. But researchers have developed antiviral drugs that can control certain serious viral infections—including AIDS and hepatitis—for long periods.

Drugs also provide important treatment for noninfectious ailments. For example, many cancers can be slowed or even cured with drugs. Drugs can control irregular heartbeats, high cholesterol, high blood pressure, and other heart disorders. Drugs containing hormones can regulate the body when glands fail or malfunction. Medications that control pain and inflammation can help arthritis patients remain active.

Surgery enables doctors to remove diseased tissues that threaten the rest of the body. For example, surgical removal of a cancer may eliminate the disease from the body. Similarly, surgeons may remove an infected appendix or gallbladder to prevent spread of the infection.

Advanced instruments and techniques have greatly reduced the damage that surgery causes to the body. For example, most operations once required large, painful incisions that took weeks to heal. Surgeons now use an instrument called a *laparoscope (LAP uh ruh skohp)* to perform many operations through tiny cuts, reducing pain and recovery time. A technique called *balloon angioplasty (an jee oh PLAS tee)* enables many patients to avoid more extensive heart operations. In this procedure, doctors thread a tiny balloon through blood vessels to the heart, then inflate the device to open clogged arteries.

Other advanced techniques enable surgeons to repair or replace damaged body parts. For example, many heart defects can be corrected surgically. Diseased bones, joints, or heart valves can be replaced with metal, plastic, or ceramic substitutes that restore normal function. Entire diseased organs can be removed and replaced with a healthy organ from another person.

Other treatments include *radiotherapy, dietary therapy, rehabilitation therapy,* and *psychotherapy.* Radiotherapy uses X rays and other radioactive sources to kill cancer cells. Diet and nutritional therapy play a major role in controlling weight and in treating diabetes, high blood pressure, and heart disease. Rehabilitation therapy can help patients recover mental and physical abilities diminished by injuries, diseases of the nerves, or other conditions. Psychotherapy provides support and helps patients examine and understand their attitudes and emotions. It is the primary treatment for emotional illnesses. Psychotherapy also helps many patients with stress-related conditions and long-term pain or illness.

National Library of Medicine

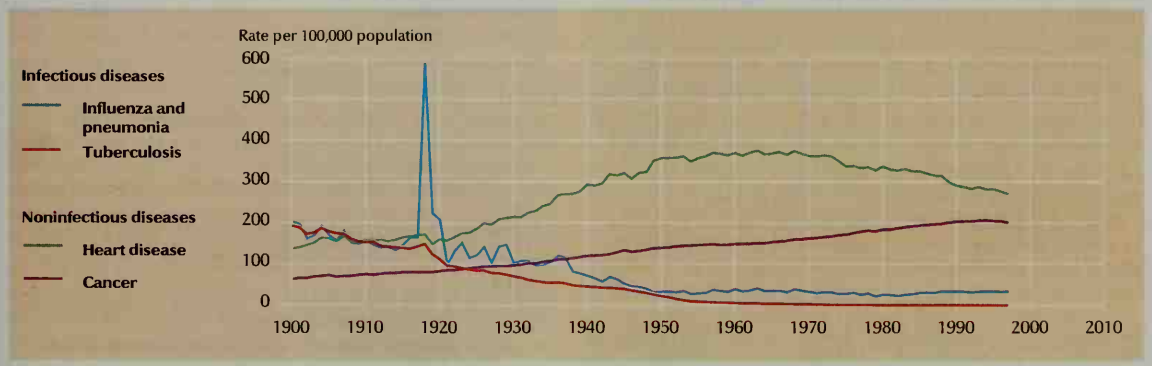
Death rates from diseases in the United States

A worldwide flu epidemic in 1918-1919 struck many otherwise healthy young people, such as the U.S. soldiers shown hospitalized in this photo, and caused the dramatic spike in influenza and pneumonia deaths that appears on this graph. The graph also shows that cancer and heart disease have now overtaken influenza and tuberculosis as causes of death in the United States.

Preventing disease

Although modern methods of diagnosis and treatment fight disease better than ever before, prevention offers the best protection against most diseases. Preventive measures rely on the combined efforts of individuals, medical professionals, and governments. Research efforts reveal new preventive strategies and identify new diagnostic procedures and treatments.

Individuals play a key role in maintaining their own health. One of the most important individual health habits is personal cleanliness, including frequent hand washing. People must also take responsibility for exercising, eating a sensible diet, getting enough rest, managing stress, and avoiding tobacco. Precautions, such as wearing seat belts and bicycle helmets, help ensure personal safety. Knowing the dangers of sexually transmitted diseases, alcohol, and illegal drugs can help people



Source: U.S. Centers for Disease Control and Prevention.

avoid unnecessary health risks.

Medical professionals provide many services that help prevent illness. Childhood immunizations prevent many infectious diseases that once caused widespread suffering and death. Regular medical checkups provide an opportunity for people to receive medical advice and other preventive care. For example, middle-aged women should regularly have breast X rays called *mammograms* to detect breast cancer in its earliest stages.

Governments. Governments at all levels play various important roles in prevention. A United Nations agency called the World Health Organization (WHO) works to protect the health of citizens throughout the world, especially in less developed countries. The United States Centers for Disease Control and Prevention (CDC) is an example of a national health protection agency. The CDC works with other national agencies to monitor outbreaks of disease around the world. The agency also recommends guidelines for treatment and prevention.

In many developed countries, national health services provide medical care to most citizens. In the United States, public programs provide health care for the poor and the elderly. Additional programs offer food and medical care for children and pregnant women.

In most developed countries, public agencies purify community water supplies and inspect food for microorganisms and harmful chemicals. Other agencies regulate the sale of medications and ensure their safety and effectiveness. Local health departments oversee sanitary disposal of sewage and waste and conduct programs to control animals that spread disease. In some nations, government agencies fight environmental pollution and unsafe working conditions.

Research into the causes and treatment of illnesses is the most important weapon against disease. Advances in medical care and prevention would not occur without knowledge provided by research. For example, intense research has shown how AIDS is transmitted and how its spread can be prevented. New treatments have also been developed. These advances have led to better understanding of how viruses work and may one day lead to cures for other viral illnesses.

Much research occurs in laboratories, where scientists explore the basic chemical and cellular processes involved in disease. Other research projects involve *epidemiologic studies.* These studies investigate patterns of disease in hopes of identifying causes and methods of prevention. Many drug studies are conducted using the *double-blind method.* This method compares the effectiveness of two similar drugs or of a drug and a *placebo* (dummy treatment). Such studies are arranged so that neither doctors nor patients know which form of treatment participants are receiving. This double ignorance—or "blindness"—of both doctors and patients gives these studies their name. This ignorance ensures that the expectations of doctors and patients will not affect patients' response to treatment. Mark W. Stolar

Related articles. For articles on specific diseases of organs or parts of the body, see the *Related articles* in such articles as **Blood, Lung,** and **Skin.** See also the following articles:

Symptoms of disease

Backache	Constipation	Cramp	Dyspepsia
Bleeding	Convulsions	Diarrhea	Fainting
Colic	Cough	Dizziness	Fatigue
Fever	Incontinence	Insomnia	Pain
Headache	Indigestion	Jaundice	Shock
Hemorrhage	Inflammation	Nausea	Vomiting
Hiccup			

Organs and conditions

Birth defect	Kidney (Kidney diseases)
Blindness (Diseases)	Liver (Diseases of the liver)
Bone	Lung (Diseases of the lungs)
Brain (Disorders of the brain)	Senility
Deafness	Skin (Skin disorders)
Eye (Diseases of the eye)	Teeth (Diseases and defects of the teeth)
Heart (Coronary artery disease)	

Other related articles

Allergy	Gulf War syndrome	Occupational medicine
Bacteria	Hantavirus	Parasite
Bill of health	Heredity (Hereditary disorders; table)	Pathology
Cell (The cell in disease)	Holistic medicine	Plant (Plant enemies)
Centers for Disease Control and Prevention	Immune system	Prion
Disabled	Immunization	Quarantine
Drug	Interferon	Races, Human (Susceptibility to genetic disease)
Epidemic	Malnutrition	Rickettsia
Fungal disease	Medic Alert	Virus
Gnotobiotics	Medicine	
	Microbiology	

Outline

I. Infectious diseases
- A. Bacterial diseases
- B. Viral diseases
- C. Other infectious diseases
- D. Spread of infectious diseases

II. Noninfectious diseases
- A. Inherited diseases
- B. Cancer
- C. Metabolic diseases
- D. Disorders of the immune system
- E. Environmental and occupational diseases
- F. Diseases associated with aging

III. Fighting disease
- A. Natural barriers
- B. Immune responses
- C. Medical treatment

IV. Preventing disease
- A. Individuals
- B. Medical professionals
- C. Governments
- D. Research

Questions

Why is antibiotic resistance a problem?
What are two diseases identified during the 1900's?
How can a regular checkup help prevent disease?
What are *genes?* How are genes involved in disease?
How do viruses reproduce?
Why do children with the disease *kwashiorkor* fail to grow?
What are two of the body's weapons against infections?
How does talking to a patient help a doctor diagnose disease?
What is an *epidemic?*
How are *communicable diseases* spread?

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Disinfectant is any substance that destroys germs on nonliving objects. Most common disinfectants are powerful chemicals that people use to sanitize clothes, rooms, and instruments and utensils. Some disinfectants include deodorizers. Detergents are added to many disinfectants to aid cleaning. Substances called *antiseptics* are used to kill germs on living tissue.

Disinfectants are most effective when added to community water and sewerage systems to destroy germs and help prevent epidemics. They also help stop the spread of germs in hospitals and other health care institutions. However, general household disinfectants have only limited value in stopping the spread of disease. In most cases, washing with soap and water is as effective as using such a disinfectant.

Important disinfectants include (1) alcohols, (2) formaldehyde and glutaraldehyde, (3) hypochlorites, (4) iodophors, (5) phenols, (6) pine oil disinfectants, and (7) quaternary ammonium compounds.

Alcohols, such as ethyl and isopropyl alcohols, are used to disinfect fever thermometers and previously cleaned plastic and rubber goods.

Formaldehyde and glutaraldehyde are strong and fast acting. Hospitals use them to disinfect surgical instruments and other medical devices.

Hypochlorites, including chlorine bleaches and chlorinated lime, are common ingredients of household disinfectants and deodorizers. They are also used in water and sewage treatment and to disinfect food utensils.

Iodophors are compounds that include iodine. They are used to sanitize large surfaces in hospitals and to disinfect equipment used in food preparation.

Phenols include carbolic acid, creosote, and hexachlorophene. They are used to disinfect floors, garbage cans, toilet facilities, and other surfaces.

Pine oil disinfectants are commonly combined with detergents to clean floors, walls, and bathroom fixtures. They have a pinelike odor.

Quaternary ammonium compounds are in many all-purpose household cleaners. They serve as both disinfectants and detergents. Christopher A. Rodowskas, Jr.

Related articles in *World Book* include:

Antiseptic
Chlorine
Creosote
Deodorizer
Formaldehyde

Dislocation occurs when any part of the body moves from its normal position. The term usually refers to the movement out of normal position of the bones of a joint (see **Joint**). When bones become dislocated, they do not meet properly at the joint. This usually results in pain and swelling.

Sometimes in dislocation the bones of a joint are pulled out of place only slightly. Physicians call this a *subluxation* or *incomplete dislocation.* In other cases, the bones become completely separated from each other. This is a *complete dislocation.* A physician corrects a dislocation by manipulating the bones to return them to their normal position. This procedure is called *reducing* the dislocation. Some dislocated joints may return to their normal position naturally. In *simple dislocation,* the patient has no external wound. A *compound dislocation* is one accompanied by a wound opening from the body surface. When a dislocation occurs in the same joint many times, physicians say it is *habitual.*

Some types of dislocation are *congenital,* or present at birth. These may be hereditary, or may be caused by some factor before or during birth. An example is congenital dislocation of the hip. Bruce Reider

See also **First aid** (Fractures and dislocations).

Dismal Swamp is one of the largest swamps in the United States. It covers about 750 square miles (1,940 square kilometers) in northeastern North Carolina and southeastern Virginia. For location, see **North Carolina** (physical map). Dismal Swamp is a tangle of vines and baldcypress, black tupelo, pine, and white cedar trees. It contains much partly decayed plant life called *peat.* Its wildlife includes bear, deer, gray fox, opossum, and snakes. Part of the original 2,000 square miles (5,200 square kilometers) of Dismal Swamp was cleared for farming. In 1973, Congress established part of the swamp as the Great Dismal Swamp National Wildlife Refuge. Stephen S. Birdsall

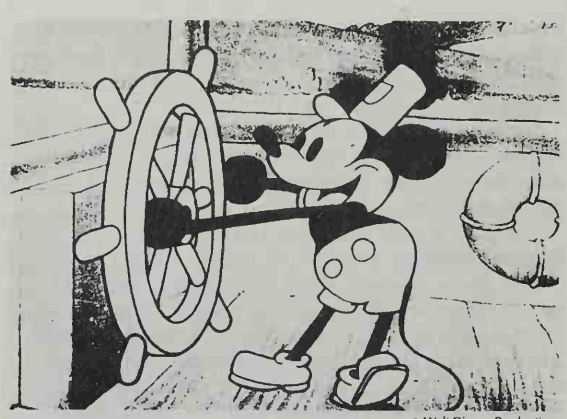
© John M. Hall

Dismal Swamp is a tangle of vines and various kinds of trees. It is one of the largest swamps in the United States.

Disney, Walt (1901-1966), was one of the most famous motion-picture producers in history. Disney first became known in the 1920's and 1930's for creating such cartoon film characters as Mickey Mouse and Donald Duck. He later produced feature-length cartoon films, movies about wild animals in their natural surroundings, and films starring human actors. Disney won 32 Academy Awards for his movies and for scientific and technical contributions to filmmaking. He also gained fame for his development of theme parks.

Early life. Walter Elias Disney was born in Chicago. His family moved to Missouri, and he spent much of his boyhood on a farm near Marceline. At 16, Disney studied art in Chicago. In 1920, he joined the Kansas City Film Ad Company, where he helped make cartoon advertisements to be shown in movie theaters.

The first Disney cartoons. In 1923, Disney moved to Los Angeles to become a film producer or director. When he failed to find a job, he returned to producing cartoons. He set up his first studio in the back half of a



© Walt Disney Productions

Mickey Mouse starred in *Steamboat Willie,* the first cartoon to use synchronized sound. Walt Disney himself provided the high-pitched voice for the character in the 1928 film.

real estate office. For several years, Disney struggled to pay his expenses. He gained success in 1928, when he released the first short cartoons that featured Mickey Mouse. Earlier filmmakers had found that animals were easier to animate than people. Mickey Mouse, drawn with a series of circles, proved ideal for animation.

In 1927, sound had been added to motion pictures, and a process for making movies in color was developed a few years later. Disney and his staff made imaginative use of sound and color. Disney himself provided Mickey Mouse's voice. His cartoon *Flowers and Trees* (1932) was the first cartoon in full Technicolor.

From 1929 to 1939, Disney produced a cartoon series called *Silly Symphonies,* which played in theaters along with other animated films featuring Mickey Mouse and such characters as Minnie Mouse, Donald Duck, Goofy, and Pluto. After 1924, Disney actually did none of the drawing necessary for his animated films. His genius lay in creating, organizing, and directing the films.

Full-length movies. In 1937, Disney issued the first full-length animated film to be produced by a studio, *Snow White and the Seven Dwarfs.* It became one of the most popular movies in history. Disney's later full-length animated films included *Pinocchio* (1940), *Fantasia* (1940), *Dumbo* (1941), *Bambi* (1942), *Cinderella* (1950), *Alice in Wonderland* (1951), *Peter Pan* (1953), *Lady and the Tramp* (1955), *Sleeping Beauty* (1959), *101 Dalmatians* (1961), and *The Jungle Book* (released in 1967, after his death). In 1950, Disney released *Treasure Island,* his first full-length movie to use only human actors. *Mary Poppins* (1964), which combines human actors with animation, probably is the most successful of Disney's later films.

During World War II (1939-1945), Disney's studio made educational films for the United States government as well as cartoon comedies. After the war, Disney created fewer animated movies. He concentrated on making films that starred real animals or human actors. In 1948, Disney released *Seal Island.* This short movie was the first in a series of "True-Life Adventures" that show how animals live in nature. Disney released his

© The Walt Disney Company

Snow White and the Seven Dwarfs (1937) was the first full-length animated film to be produced by a movie studio. In this scene, the evil witch offers Snow White a poisoned apple.

© The Walt Disney Company

Disney studied a live penguin during the creation of *Peculiar Penguins* (1934) in the cartoon series *Silly Symphonies.* This series used classical music to set a cartoon's mood and theme.

© The Walt Disney Company

Donald Duck dances with the energetic Brazilian parrot Joe Carioca in *Saludos Amigos,* a 1943 production that combined four cartoon segments with real-life film on South America.

© The Walt Disney Company

Lady and the Tramp ranks among Disney's most popular animated feature films. The movie follows the adventures of the well-bred dog Lady and her romancing, mongrel friend Tramp.

© The Walt Disney Company

The Living Desert was the first full-length nature motion picture. This 1953 film captured scenes of desert life rarely seen by human beings, such as a kangaroo rat encountering a snake.

Shooting Star Archives

Walt Disney opened the Disneyland theme park in 1955. The park was based on many of the films that Disney produced in a motion-picture career that began in the 1920's.

first full-length nature film, *The Living Desert,* in 1953. All his nature movies include scenes of animal life rarely seen by human beings.

TV and theme park ventures. After television became popular about 1950, many filmmakers either ignored TV or fought it as a threat to the movie industry. But Disney adjusted easily to the new form of entertainment. He hosted a weekly show that presented Disney films made especially for television, featuring such characters as Davy Crockett and Ludwig Von Drake.

Disney achieved one of his greatest successes in 1955, when he opened Disneyland, a spectacular theme park in Anaheim, California. Many of the attractions at the park are based on Disney films.

During his last years, Disney developed plans for building a huge entertainment and educational complex in Florida. This project, known as Walt Disney World, was completed after Disney's death.

The Walt Disney Company, with headquarters in Burbank, California, carried on Disney's work after his death. For more information on the company's films, theme parks, and merchandise, see **Walt Disney Company.** David R. Smith

See also **Animation** (History); **United States** (The arts [picture]).

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Disney World. See Walt Disney Company; Florida (Places to visit; picture); **Orlando.**

Disneyland. See Walt Disney Company; Anaheim; California (Places to visit; picture).

Displaced person. See Refugee.

Displacement behavior refers to any of a variety of activities that seem inappropriate in the situation in which they occur. For example, some mammals groom their fur when faced with a decision of whether to fight or run away. Most displacement behaviors occur during times of emotional conflict. George B. Johnson

Disraeli, *dihz RAY lee,* **Benjamin** (1804-1881), was one of the most important British political leaders of the 1800's. He was prime minister of Britain in 1868 and again from 1874 to 1880. Disraeli was the first person of Jewish ancestry to be prime minister in Britain.

Disraeli was born in London. His father, Isaac D'Israeli, was a well-known author. D'Israeli had Benjamin baptized into the Church of England at the age of 13. In the 1820's, the younger Disraeli also began a writing career. But in time he decided to enter politics. After several failed attempts to win a seat in Parliament, Disraeli was elected to the House of Commons as a Conservative in 1837.

In Parliament, Disraeli became a leading spokesman of the most conservative interests. He opposed the repeal of the Corn Laws, which taxed British imports of grain. In 1846, Disraeli became a leading figure of the Conservative Party in the House of Commons. In 1852, 1858, and 1866, he became chancellor of the exchequer in Conservative governments that the Earl of Derby headed from the House of Lords.

National Portrait Gallery, London

Benjamin Disraeli

Disraeli played an important role in the passage of the Reform Act of 1867. The act brought greater democracy to Britain by giving the vote to many city workers and small farmers. In 1868, Disraeli became prime minister. He lost the position to William Gladstone, the leader of the Liberal Party, later in 1868 but regained it from Gladstone in 1874.

As prime minister, Disraeli followed a strong foreign policy. In 1875, he purchased for Britain a large interest in the Suez Canal, a key link in the shipping route that connected Britain and its vast empire in India and the Far East. At the Congress of Berlin in 1878, Disraeli helped prevent Russian expansion in Turkey and won Cyprus for Britain. The Disraeli government also worked to improve living conditions in Britain. It passed measures affecting health, housing, the environment, trade unions, and working conditions.

Disraeli wrote several novels dealing with politics and high society. His major novels include *Coningsby* (1844), *Sybil* (1845), and *Tancred* (1847). He was made Earl of Beaconsfield in 1876. Richard W. Davis

See also **Conservative Party; Corn Laws.**

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Dissection. See Anatomy.

Distance learning is a process in which students learn by using resources that are far away from them, even in another city or country. The students gain access to the resources, including instructors, by using communications technology. The technology may be as simple as printed materials delivered by mail or as advanced as interactive conferencing by computer over the World Wide Web. Distance learning places greater responsibility on the student than traditional learning does. The teacher or instructor serves more as a guide or coach than as a regular teacher.

Distance learning dates from the mid-1800's, when universities first conducted correspondence courses by mailing printed materials and assignments to students' homes. The concept gained wider acceptance with the founding of the Open University of the United Kingdom (now the British Open University) in 1969. The school was set up to provide courses for students who could not attend classes at traditional universities. The school has served as a model for hundreds of other open universities around the world that offer distance learning programs.

As communications technologies have evolved, so has distance learning. In the 1950's, some institutions began to use television broadcasts to deliver instruction to students. In the 1990's, distance learning increasingly involved the use of computers and the integration of various media and technologies. Today, students may receive audio and video materials through satellite transmissions, broadcasts, or the Internet, or through computer programs on CD-ROM's or other media. Students may also participate in conferences on the World Wide Web and other computer networks.

Lynn A. Fontana

See also **Correspondence school.**

Distemper is a contagious disease of dogs and other animals. In dogs, it is caused by a virus called *paramyxovirus.* This virus affects chiefly young dogs and is often fatal. It also infects such animals as foxes, minks, skunks, raccoons, and wolves. The word *distemper* also refers to different diseases in horses and cats.

A dog with distemper suffers from fever, reddened eyes, loss of appetite, a dry mouth, and discharges containing pus from the nose and eyes. As the disease progresses, pneumonia may occur and bring on coughing and heavy breathing. The virus frequently spreads to the brain and results in jerking motions of the head, jaw, and other parts of the body. This motion is called *chorea.* Brain infection usually leads to death.

Vaccination is the most effective means of preventing distemper. Dogs suffering from this disease require the care of a veterinarian. Dogs that recover from distemper are immune to it for several years or their entire lifetime.

Distemper in horses is caused by *Streptococcus equii* bacteria. In young horses, this disease is called *strangles.* The horse suffers from a sore throat, fever, and swollen lymph glands. Horses treated with penicillin or other drugs frequently recover.

Distemper in cats is called *panleukopenia,* also known as *feline distemper.* The disease is caused by a virus called *parvovirus.* Panleukopenia infects the bone marrow, intestine, and lymphoid tissue. The cat suffers from diarrhea, a runny nose, and reddened and runny eyes. Vaccination can protect cats from it. Treatment requires the care of a veterinarian. Lawrence D. McGill

Distillation, *dihs tuh LAY shuhn,* is a process that separates a substance or a mixture of substances from a solution through vaporization. Many industrial processes depend on distillation. Distillation usually involves boiling a liquid and condensing the vapor that forms.

Water that is treated by this process forms *distilled water.* This is purer than the original water because salt and other impurities do not evaporate with the water.

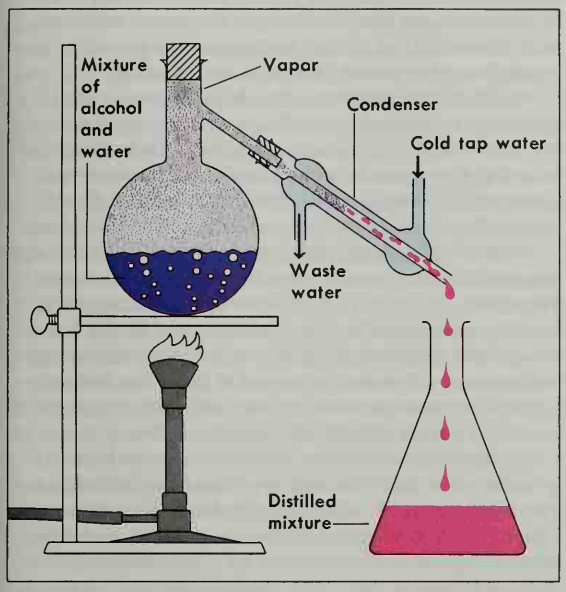
Distillation is carried out in an apparatus called a *still.* A still consists of a *boiler,* a *condenser,* and a *receiver.* The mixture to be vaporized is heated in the boiler. Whichever substance in the mixture boils at the lowest temperature will be the first to turn into vapor. The vapor enters the condenser, where it cools and becomes liquid again. The distilled liquid, called the *distillate,* then collects in the receiver.

Two general methods are used to distill liquids, *simple distillation* and *rectification.* In simple distillation, all the distillate is removed from the still after collecting in the receiver. In rectification, part of the distillate flows back into the still. This portion comes into contact with the vapor being condensed and enriches it.

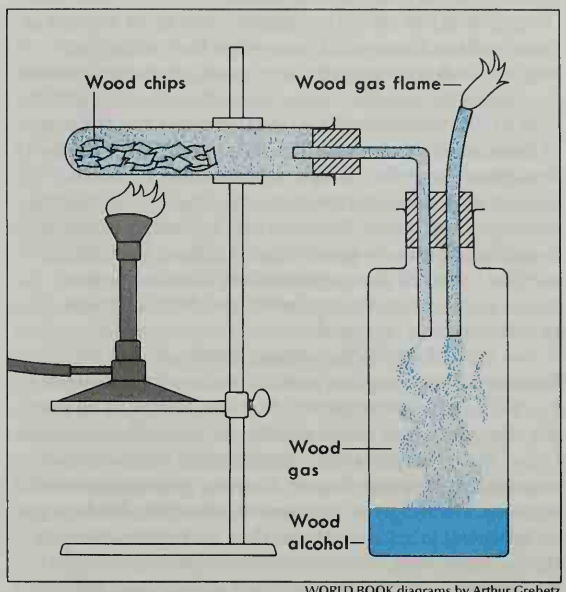
Simple distillation. Two common techniques used in this method of distillation are *fractional distillation* and *flash distillation.*

Fractional distillation, also called *differential distillation,* separates a mixture of liquids that boil at different temperatures. For example, alcohol boils at 172 °F (78 °C), and water boils at 212 °F (100 °C). When a mixture of

Types of distillation



Simple distillation separates substances in a liquid. It can be demonstrated by heating a mixture of alcohol and water in a flask. When the mixture boils, it turns into vapor. The vapor has a higher percentage of alcohol than the liquid mixture did, because alcohol boils at a lower temperature than water. The vapor liquefies in the condenser and flows into the receiver.



WORLD BOOK diagrams by Arthur Grebetz

Destructive distillation, which involves chemical changes in solids, produces new substances. It can be shown by heating wood chips in a closed tube at a temperature high enough for the wood to *decompose* (separate chemically). This decomposition produces wood gas. The gas burns with a luminous flame if lit. When the gas condenses in the jar, it forms wood alcohol.

these liquids is heated, the alcohol vaporizes faster than the water. But the water also vaporizes at the boiling point of alcohol. As a result, the distillate from a mixture of alcohol and water contains some water. The first distillate collected has a larger proportion of alcohol than the portions that condense later. Therefore, the first distillate is removed before much water distillate has condensed. In the same way, the remaining distillate is collected in *fractions* (portions), which can then be redistilled for a purer product. Fractional distillation is used in making distilled liquors. See **Alcoholic beverage; Distilling.**

Flash distillation involves passing a liquid from a vessel maintained at a high pressure to one kept at a lower pressure. No heating is required to produce vapor by this method. The lower pressure causes part of the liquid to *flash* (turn quickly) into vapor, which is then condensed into distillate. In fractional distillation, the distillate can be processed only in batches. But in flash distillation, a continuous flow of liquid can be distilled. Flash distillation is widely used to turn ocean water into fresh water. See **Water** (Distillation).

Rectification separates many different substances from a solution by using large towers called *fractionating columns.* As the mixture is heated, its vapors rise through these columns. Substances that boil at the lowest temperatures form the first fractions. Their vapors rise highest and are carried off by pipes near the tops of the fractionating columns. Separate pipes carry off different fractions at various levels. The *reflux* (return) of some distillate to the columns produces the most efficient conditions for this method of distillation. Like flash distillation, rectification can be carried out with a continuous feed of liquid. Rectification plays a role in chemical processing, including petroleum refining. See **Petroleum** (Refining petroleum).

Destructive distillation. No new substances are formed during simple distillation or rectification. Each of these processes simply separates substances that have been mixed together. But when some solids are heated in a closed vessel, they *decompose* (separate chemically) and produce new substances. For example, wood heated in an airtight tube decomposes into wood gas, which in turn condenses and forms wood alcohol. This process, which involves chemical changes, is called *destructive distillation.* Manufacturers use destructive distillation to produce coal tar from coal. John B. Butt

See also **Evaporation.**

Distilling is a process used in manufacturing various alcoholic beverages, including whiskey, brandy, vodka, gin, and rum. These beverages, sometimes called *spirits,* are made from a "mash" of grains or from various fruit juices. Sugar in the mash or juice is converted into alcohol by a chemical process called *fermentation* (see **Fermentation**). Distilling begins when the fermented mixture is heated, turning the alcohol into vapors. The vapors are collected and then cooled back into a liquid to produce alcoholic beverages (see **Distillation**).

Distilling takes place in equipment called a *still.* There are two main types of stills. The *pot still* distills one batch of liquid at a time. It is used to make tequila, Scotch whisky, Irish whiskey, and a type of brandy called *cognac.* Other spirits are made in *column stills,* which permit continuous distillation. Column stills are

the type most often used by distilleries in the United States to make whiskey and vodka.

Most kinds of spirits contain from 40 to 50 percent alcohol. All spirits are colorless when first made. But whiskey darkens naturally, and some spirits are artificially colored by manufacturers. The different kinds and flavors of distilled alcoholic beverages depend on the type of fermented mixture used. Distillers produce brandy from fermented fruit juices. Whiskey and vodka are made from various fermented grain mashes, including corn, rye, and wheat. Rum is made from fermented molasses or sugar-cane juice. Tequila comes from the fermented juices of the maguey plant. Manufacturers blend alcohol vapors with additional flavoring materials to make gin. F. A. Meister

See also Alcoholic beverage; Whiskey.

District attorney is a public official whose chief duties are bringing charges against and prosecuting people charged with a crime or offense. This official is also called the county attorney, prosecuting attorney, commonwealth attorney, deputy attorney general, or state's attorney. District attorneys are the attorneys for the state, or "people," in criminal trials. They may act as attorney for the government in civil suits to collect taxes or to take property for public use. They may appear for the defense in suits brought against the government. In most states, they have jurisdiction only in a given county. They are elected in some states and appointed in others.

United States district attorneys are officially called United States attorneys. They are appointed by the president and are responsible to the attorney general. A U.S. attorney is appointed for each federal judicial district for a term of four years. United States attorneys serve as attorney for the government when it prosecutes for federal crimes, sues, or is sued. Jack M. Kress

District court is the court in which most federal cases are first heard in the United States. The district court ranks below the court of appeals. In a district court, questions of fact are decided by a jury, or, if the parties wish, by a judge. The first full hearing of a case is called a trial, and the district court is called a *trial court.* The district court decides on the truth of contested events, and its decision on the facts of a case is final. But the rules of law used by the court may be reviewed by a higher court, on appeal. The appeal is usually to one of the Courts of Appeals. The Supreme Court of the United States may review a Court of Appeals decision.

There are about 95 district courts in the United States and its possessions. Each court has one or more judges, and one United States attorney. There are a total of about 565 permanent district court judges. Each is appointed for life by the president, subject to U.S. Senate approval. The courts hear most federal criminal cases, as well as civil suits arising under postal, patent, copyright, and internal revenue laws. Jack M. Kress

See also Court of appeals; Court (Federal courts).

District of Columbia (D.C.) is the seat of the U.S. government. It covers 68 square miles (177 square kilometers) along the Potomac River between Maryland and Virginia. The city of Washington covers the entire District. For more information, see Washington, D.C.

Disulfiram, *dy SUHL fuh ram,* is a drug used to treat alcoholism (see Alcoholism). It is commonly known by the trade name Antabuse. Disulfiram does not cure alcoholism, but it discourages people from drinking alcoholic beverages. People who take disulfiram become sick if they drink alcoholic beverages. Symptoms include heavy breathing, dizziness, and vomiting.

People taking disulfiram should avoid any alcohol product. For example, cough syrup, tonics, and even after-shave lotion may result in sickness. When alcohol is avoided, there may be only mild side effects, such as drowsiness, headaches, or skin problems. Disulfiram should be taken only when prescribed by a physician. Two Danish physicians, Jens Hald and Erik Jacobsen, discovered the drug's usefulness in 1948. Kenneth Blum

Diuretic, *DY yu REHT ihk,* is a drug or substance that increases the amount of urine discharged by the kidneys. Most diuretics especially increase the amount of sodium and chloride discharged in the urine. Natural substances such as water, coffee, tea, beer, and sugar solutions have a diuretic effect on the kidneys.

Some drugs are used as diuretics to lower blood pressure in individuals with hypertension. Such drugs reduce the volume of blood in the body. Diuretics may also be used to treat congestive heart failure and other diseases that are accompanied by a condition called *edema.* Edema occurs when the body retains too much fluid and often visibly swells as a result. Diuretics may cause a loss of potassium and other important substances in the body. If such losses are not made up, they may cause seizures or heart or blood problems.

Barbara M. Bayer

See also Edema.

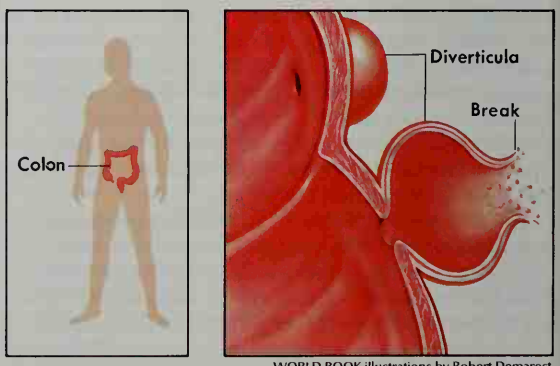
Diver. See Diving, Underwater.

Diversified farming. See Agriculture (Mixed farms).

Diverticulitis, *DY vuhr TIHK yuh LY tihs,* is a common disease of the *colon* (part of the large intestine). Its symptoms include pain in the lower left part of the abdomen and a fever. The disease develops from *diverticulosis,* a disorder widespread among middle-aged and elderly people in North America and northern Europe.

Diverticulosis involves the presence of pouches called *diverticula* along the outside of the colon. Diverticula rarely form in people under the age of 30. Most diverticulosis patients have no symptoms.

Evidence suggests that a diet high in fiber can help prevent diverticulosis. Good sources of fiber include



WORLD BOOK illustrations by Robert Demarest

Diverticulitis is a disease of the colon. It occurs when a *diverticulum,* an abnormal pouch on the surface of the colon, is inflamed. An inflamed diverticulum may break open, releasing infectious waste materials.

beans, fruits, leafy vegetables, and nuts. A shortage of fiber in the diet makes the waste material in the colon extremely firm and compact. The waste cannot move easily through the colon, and high pressure results. This pressure can force the inner membrane of the colon to bulge out through weak points in the lining of the organ. Such action forms small, permanent diverticula that may be seen with an X-ray examination.

In the United States, the diets of most people are relatively low in fiber. Nearly half of those over 60 have diverticulosis. The condition rarely occurs in less developed nations, where the standard diet is high in fiber.

Diverticulitis develops in many cases of diverticulosis. It results when one or more of the diverticula are inflamed. The inflamed diverticula may break open. The material that leaks out infects the outer surface of the colon. In most cases, the infection stays in a small area. But it may spread and develop into *peritonitis,* a severe illness that can cause death (see **Peritonitis**).

Doctors treat diverticulitis with antibiotics to control infection, drugs to relax the muscle of the colon, and compounds to help empty the colon. In severe cases, surgeons may remove the inflamed part of the colon. A diet high in fiber may help prevent a recurrence of the disease. A. William Holmes

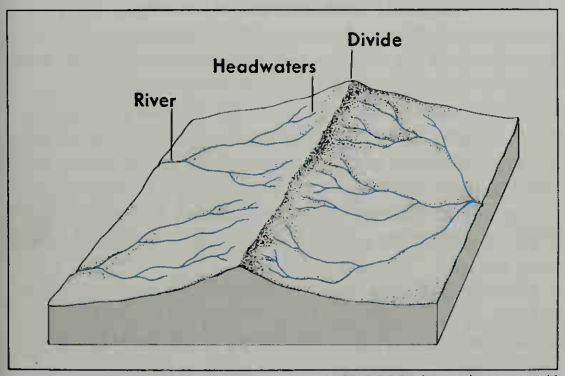
See also **Fiber, Dietary.**

Divide is a high place on the land, situated so that the streams on one side flow in the opposite direction to the streams on the other side. These streams then flow into different river systems, which may empty into different oceans. The little streams are called the *headwaters* of the river systems. The divide separates the headwaters of the systems.

A divide may be rather low, like the height of land that runs from east to west across North America. This divide separates the rivers that flow generally northward into the Gulf of Saint Lawrence, Hudson Bay, and the Arctic Ocean from those that flow into the Mississippi basin. Some divides are very high with steep slopes, like the Rocky Mountains. This separates the rivers flowing into the Mississippi and the Gulf of Mexico from those flowing into the Pacific Ocean. The divide that runs north and south through the Rocky Mountains is called the *Great Divide* or the *Continental Divide.*

On Cutbank Pass in Glacier National Park, there are three brooks so close together that a person can pour water into all three at the same time. One brook carries water to Hudson Bay, another to the Pacific Ocean, and the third to the Gulf of Mexico. In the Rocky Mountains, sources of streams flowing to the Pacific and to the Gulf lie only a short distance apart. Richard G. Reider

See also **Continental divide; Great Divide.**



WORLD BOOK diagram by Marion Pahl

A divide is a high area of land that separates river systems from one another. The headwaters of each system form near the top of the divide. The waters join and form streams and rivers.

Divider is a drafting instrument used to divide lines and transfer measurements. A divider has two needle-pointed legs, joined at the top. An adjusting screw changes the distance between the points. A *proportional divider* helps reduce and enlarge drawings. Its legs are pointed on both ends and crossed. The user adjusts it so that the distance between points on one end is a certain fraction of the distance between points on the opposite end. The user can then pivot the legs to change either distance. When the legs pivot, the other distance also changes, with the fractional relationship between the distances remaining the same. Dividers are a type of caliper (see **Caliper**). Todd I. Blue

Divination, *dihv uh NAY shuhn,* is the practice of trying to learn about the unknown by magical or supernatural means. A diviner supposedly can learn about the past, present, or future. Some diviners believe they can learn the causes of past events, such as a person's illness or death. Other diviners, called *dowsers,* claim they can find the location of underground water. Still others believe they can foretell events, such as when a person will die or whom a person will marry.

There are many kinds of divination. For example, *necromancy* involves communicating with the spirits of the dead. *Astrology* is an attempt to predict events by studying the positions of the sun, moon, stars, and planets. Some diviners interpret dreams to foretell events. *Palmistry* involves the prediction of events by reading the lines and marks of the hand. Some fortunetellers claim to read messages in coffee grounds, tea leaves, dried mud, or crystal balls. Others use *tarot cards,* a special deck of pictured playing cards, to tell the future.

Throughout history, people have believed in the powers of divination. In ancient Greece and Rome, prophets known as *oracles* foretold events by interpreting messages from the deities.

At one time, courts used divination to determine the guilt or innocence of criminals. Divination in a trial was called an *ordeal.* For example, in many witch trials of the 1600's in Europe and colonial America, a suspected witch was tied up and thrown into water. If she sank, she was considered innocent. If she floated, she was considered a witch—and was executed. Alan Dundes

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Augur	Magic	Ouija board	Well (Locating wells)
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Divine, Father (1880?-1965), was a black American religious leader and the founder of the Peace Mission Movement. The movement worked to end poverty, racial discrimination, and war. Father Divine had a luxurious lifestyle and was often criticized for it. But his goals, spiritual leadership, and generosity attracted support in cities throughout the United States.

Father Divine's real name was George Baker. He was born in Georgia, but little else is known about his early

life. In 1915, he opened his first church in New York City and soon took the name Major J. Devine. His followers, known as *angels,* were encouraged to live together in houses called *heavens* and to contribute their incomes to the Peace Mission Movement. During the Great Depression, grocery stores and other businesses owned by the movement provided food, clothing, and other goods to the poor at little or no cost. Devine's followers began to regard him as God and called him *Father Divine.* After he died, interest in the movement declined sharply. Fredrick Woodard

UPI

Father Divine

Divine Comedy is a beautiful, long epic poem by the Italian writer Dante Alighieri. Dante began the poem about 1308 and finished it just before his death in 1321. Its main theme is life after death, and Dante himself is the chief character. *The Divine Comedy* is divided into the *Inferno* (Hell); the *Purgatorio* (Purgatory); and the *Paradiso* (Paradise). Dante called the work simply *Commedia* (Comedy) because it ended happily. Later generations added the word *Divine.*

Dante divided each of the three parts of the poem into subdivisions called *cantos. Purgatorio* and *Paradiso* each contain 33 cantos, and *Inferno* has 34. The cantos have a powerful rhythm because of their three-line *terza rima* stanzas. In this verse form, which Dante invented, the first and third lines of each stanza rhyme with the middle line of the preceding stanza.

The poem begins with Dante lost in a dark forest, symbolizing what he felt was his own unworthy life and the evil he saw in society. On Good Friday, after a night of painful wandering, he meets the Roman poet Virgil, who promises to lead him out of the forest and guide him on a journey through the otherworld. They enter hell, a horrible pit shaped like a cone, located deep within the earth. It has nine circles where they find crowds of suffering individuals who are being punished for their sins by monsters, devils, and other creatures. The damned are well-known historical figures, some from the past, but most from Dante's own time.

Dante and Virgil leave hell and reach the mountain of purgatory. From there they climb to bright terraces where the dead, who have gained salvation, seek forgiveness for misdeeds committed on earth. An atmosphere of peace and hope fills this place of purification, in contrast with hell's suffering and despair.

On reaching the earthly paradise, on top of Mount Purgatory, Virgil entrusts Dante to a new guide, Beatrice. *The Divine Comedy* is in many ways a love poem praising Beatrice's moral beauty and her power to lead Dante to a vision of supreme goodness. She guides Dante through the 10 spheres of heaven, where Dante meets the souls of the blessed. They finally arrive at the throne of God, set among hosts of angels. Dante stands in rapture and perceives at last the final truth of life and the meaning of the universe. Richard H. Lansing

See also **Dante Alighieri.**

Divine proportion. See Golden section.

Divine right of kings is the belief that monarchs get their right to rule directly from God, rather than from the consent or wish of their subjects. According to this belief, it is up to God to punish a wicked king. So far as the people are concerned, "the king can do no wrong" and ought to be obeyed.

This idea was at its height during the 1600's, especially in England during the reign of the Stuarts and in France under Louis XIV. The first blow at divine right was the execution of King Charles I of England in 1649. In the late 1700's, the French Revolution repudiated the belief and asserted that the right to rule came from the people. But the divine-right doctrine lasted long after that time. It was asserted in the early 1900's by the German Emperor Wilhelm II as king of Prussia, and by Czar Nicholas II of Russia. Roger Howell, Jr.

Diving is an exciting water sport that involves plunging head first or feet first into the water. A skillful diver leaps from a springboard or a platform and performs daring acrobatics in the air before entering into the water. Unlike swimming, diving emphasizes technique rather than endurance or speed. Talented divers combine strength and grace with great courage while spinning and twisting toward the water.

Some divers perform trick dives at water shows, and others plunge into the water from cliffs. Such divers have great skill and daring, but they perform mostly as entertainers. This article discusses diving as a national and international competitive sport. For information on other forms of diving, see **Diving, Underwater; Skin diving**; and **Spearfishing.**

Types of diving

National and international diving meets consist of two types of competition, *springboard diving* and *platform diving.* In springboard diving, the diver uses the spring from a flexible board to gain the height necessary to perform a dive. In platform diving, the diver jumps from a stationary surface.

Springboard diving. Diving boards used in meets measure 16 feet (5 meters) long and 20 inches (51 centimeters) wide. They extend about 6 feet (1.8 meters) beyond the edge of the pool. Springboard diving competitions are held on boards that are either 1 meter (3 $\frac{1}{2}$ feet) or 3 meters (10 feet) above the water.

In the 1960's, the development of aluminum diving boards revolutionized springboard diving. Aluminum springboards are thinner and more flexible than the earlier thick wooden ones. They provide greater spring, making it easier for the diver to spin as well as to gain more height. This increased height and spinning action allows athletes to perform a greater variety of dives, including many more difficult ones. Newer aluminum springboards that were first introduced during the 1980's enable divers to gain even more height and spinning action.

Platform diving. Diving platforms for meets must be at least 20 feet (6 meters) long and 6 $\frac{1}{2}$ feet (2 meters) wide. They have a nonskid surface to prevent athletes from slipping. Diving platforms used in competitions are 10 meters (33 feet) above the water. Some platforms have levels that are 5 meters (16 feet) or 7.5 meters (25 feet) high. During the Olympic Games, divers use these

lower levels only for practice. However, divers in younger age-group competition may use them in meets.

Diving techniques

Diving is safe for properly trained athletes, but good diving requires proper coaching and equipment. Beginners risk serious injury if they do not learn proper techniques, and so a trained, certified diving instructor is essential. Difficult dives should never be attempted from a backyard or motel pool diving board.

The first movement for many dives consists of the *approach* and the *hurdle*. The approach consists of at least three steps taken by the diver on the board or platform. The hurdle is the last step—actually a short jump—that takes the diver to the edge of the board or platform. The approach steps should be natural and even in length. Steps that are too long or too short may result in shifts in weight that can cause imbalance.

Some platform dives begin with a *standing start*. The diver stands poised at the platform's edge. Other platform dives begin with an armstand at the edge.

All dives involve movements that divers must follow precisely while in the air. Ideally, a diver enters the water vertically, with the body straight and the toes pointed. When the diver enters the water head first, the arms must be extended over the head with the elbows locked and pressed against the ears in line with the body. If the diver enters the water feet first, the arms should be straight and placed firmly against the sides.

Kinds of dives

Springboard and platform dives are divided into dive groups. Springboard competition has five groups. Platform diving has six groups. A diver must perform a dive from each group in a meet. The groups are determined by the direction of the dive off the board.

Dive groups performed in both springboard and platform meets are (1) forward, in which the dive action moves straight ahead; (2) back, in which the diver stands backward and the dive action moves away from the board; (3) reverse, in which the diver starts forward but the dive action rotates back toward the board; (4) inward, in which the diver starts backward and the dive action moves toward the board; and (5) twist, in which the diver adds a *pirouette* (complete body rotation) to the dive action of a dive selected from any of the groups. In a sixth platform group, the armstand, the diver's starting position is a balanced armstand at the end of the platform. All the groups consist of basic dives and progressively harder variations of them. All the variations in the first four groups and armstand group include at least one somersault.

Divers perform all dives except for some twist dives in one of three positions: (1) straight, (2) pike, and (3) tuck. In the straight position, the diver keeps the body straight. In the pike position, the athlete bends at the hips and keeps the knees straight. In the tuck position, he or she bends at the waist and knees by pulling the knees up toward the chest, and grasping the lower legs with the hands. A fourth position, the *free* position, is used only in certain twist dives. Dives in the free position combine any of the three other positions, depending on the kind of twist dive.

Diving meets

The United States, Canada, and many other countries hold national championship diving meets annually. International meets are held the year around. Diving meets are held indoors and outdoors. Men and women compete separately, but they perform the same dives and use the same boards and platforms. Every meet consists of required and optional dives. The judging and scoring procedures are the same for men's and women's diving.

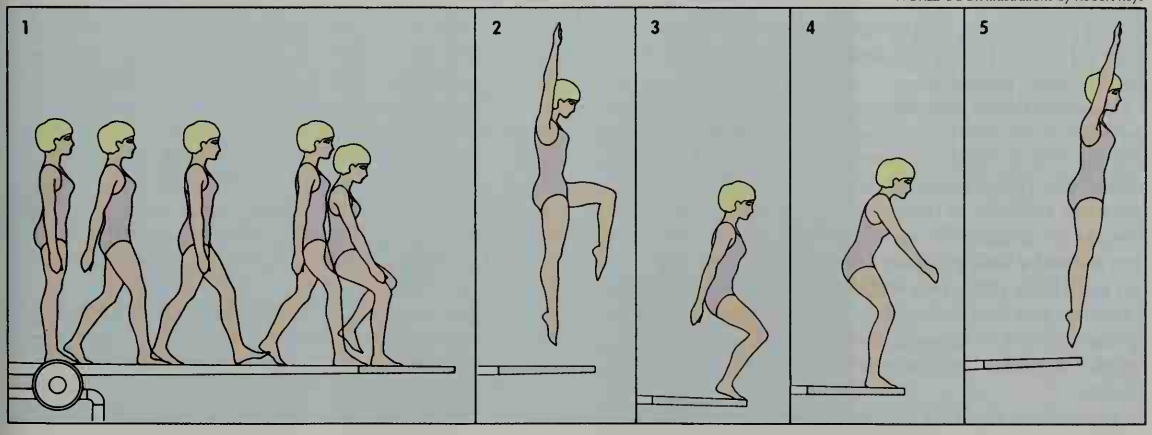
The top national and international diving meets are conducted under regulations established by the Fédération Internationale de Natation (FINA). FINA is the international governing body for diving, competitive swimming, water polo, and a graceful, acrobatic swimming sport called *synchronized swimming*.

Required and optional dives. FINA assigns each dive a *degree of difficulty*. Degree of difficulty is based

Beginning a springboard dive

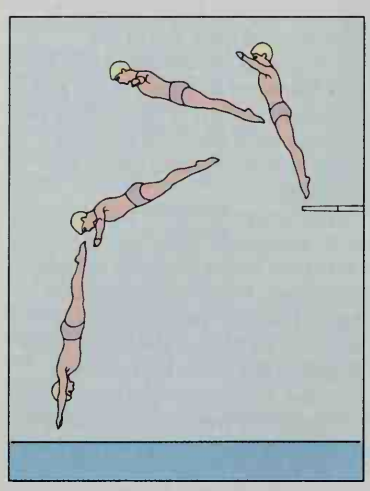
A diver must perform a series of movements to begin a dive properly. The most important movements for most dives are the *approach* and the *hurdle*. (1) The approach consists of at least three steps on the springboard. (2) The hurdle is a short jump that takes the athlete to the edge of the board. (3) The diver's arms swing down as the board goes down. (4) They swing up as the board rebounds. (5) The take-off lifts the diver high into the air.

WORLD BOOK illustrations by Robert Keys

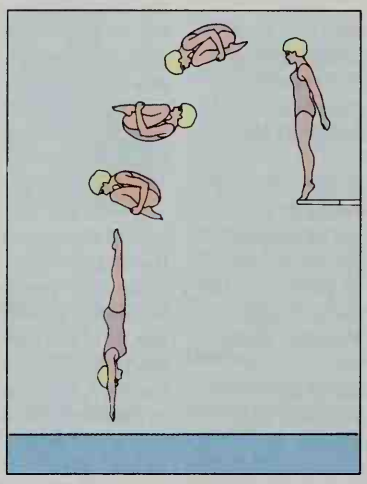


Kinds of dives Divers must perform dives from five groups in a springboard meet. Divers can select dives of varying difficulty within each group. The illustration below shows six dives, their group, and the diver's position—pike, straight, or tuck.

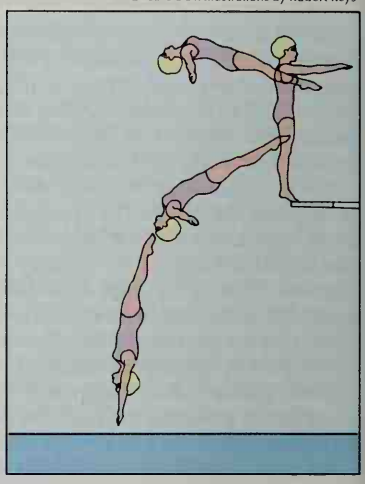
WORLD BOOK illustrations by Robert Keys



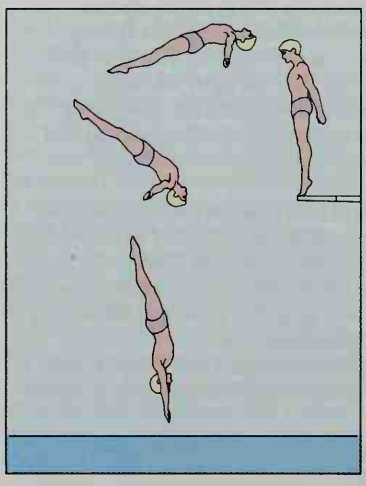
Forward dive (forward group, straight position)



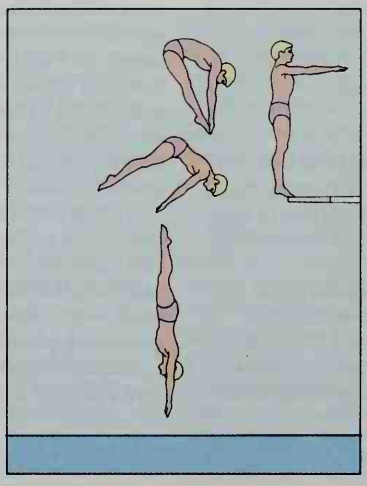
Forward 1 $\frac{1}{2}$ somersault (forward group, tuck position)



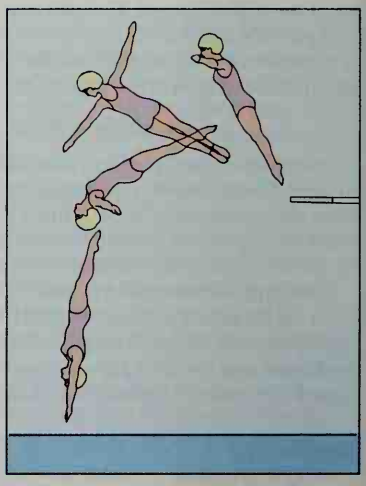
Back dive (back group, straight position)



Reverse dive (reverse group, straight position)



Inward dive (inward group, pike position)



Forward one-half twist (twist group, straight position)

on (1) the position, (2) the number of twists, (3) the number of somersaults, and (4) whether the dive is performed on the 1-meter or 3-meter springboard or from the 10-meter platform.

In national and international springboard meets, men perform 11 dives. These dives include 5 required dives, also known as voluntary dives with limit, and 6 optional dives, also called voluntary dives without limit. Women perform 10 dives—5 required and 5 optional. The total degree of difficulty for an athlete's required dives must not exceed a limit assigned by FINA. Optional dives have no such limit. Both men and women must perform one required and one optional dive from each of the five groups of dives—forward, back, reverse, inward, and twist. The men's sixth optional dive may be from any group.

In platform meets at the national and international level, men perform four required and six optional dives. Women perform four required and five optional dives. Both men and women choose from six groups of dives. None of the groups can be repeated. As in springboard diving, the total degree of difficulty for required dives may not exceed a standardized limit.

Scoring and judging. Judges evaluate each diver's approach, take-off, grace and technique in the air, and entry into the water. Each judge awards points and half points on a scale of 0 to 10. A score between 0 to 4 $\frac{1}{2}$ is unsatisfactory, 5 to 6 $\frac{1}{2}$ satisfactory, 7 to 8 $\frac{1}{2}$ good, and 9 to 10 outstanding.

Diving meets use a panel of judges to obtain three impartial scores. In most meets, divers are judged by five to seven judges. But in some meets, divers are judged by as few as two or as many as nine judges. In meets that use five, seven, or nine judges, a diver's high-

est and lowest scores are dropped. The remaining scores are added and then multiplied by the dive's degree of difficulty. The result is the score for that dive.

The final meet score is the sum of scores for all dives the athlete did in the competition. The final score is adjusted to make the results comparable to scores obtained in meets using three judges. In competitions that use two judges, no scores are dropped. But the final score is adjusted to make it comparable to those in meets using three judges. Micki King

See also **Swimming** (Starts and turns; pictures); **Olympic Games**

Additional resources

Goldberg, Bob. *Diving Basics.* Prentice Hall, 1986. Younger readers.
O'Brien, Ron. *Ron O'Brien's Diving for Gold.* Leisure Pr., 1992.
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Diving, Underwater, is the way people reach the strange and beautiful world beneath the surface of oceans, lakes, and rivers. Ancient peoples dived underwater in search of fish, other water animals, and plants for food. With improved skills and equipment, many activities began to be performed underwater.

Today, divers repair ships, recover valuable objects, build and repair various types of structures, and conduct research. Work can be performed at great depths in specially equipped diving vehicles. In the armed services, divers and submarines carry out military missions. Many people enjoy underwater diving as a sport. They dive to study underwater life, to take photographs, to hunt water animals, or simply to explore.

Kinds of underwater diving

There are two basic kinds of diving: (1) *ambient diving,* in which the diver's body is exposed to the pressure of the *ambient* (surrounding) water; and (2) diving in vehicles that protect divers from the water pressure.

Ambient diving. Water pressure on the body increases with water depth. At great depths, this pressure can have dangerous effects on an ambient diver. The three types of ambient diving are (1) breath-hold diving, (2) scuba diving, and (3) surface-supplied diving.

Breath-hold diving is the oldest and simplest form of underwater diving. It is also called *free diving, skin diving,* and *snorkel diving.* Breath-hold divers may use no equipment at all, but most of them use a face mask, foot fins, and a short breathing tube called a *snorkel.* The snorkel allows the diver to swim at the surface and observe underwater before diving.

Most breath-hold divers can go only 30 to 40 feet (9 to 12 meters) deep. They must surface to breathe after less than a minute. Some skilled divers can go as deep as 100 feet (30 meters) and stay submerged for as long as two minutes.

Scuba diving gives divers greater mobility and range than breath-hold or surface-supplied diving. The word *scuba* stands for *s*elf-*c*ontained *u*nderwater *b*reathing *a*pparatus. A scuba diver wears metal tanks that hold compressed air or a special mixture of breathing gases. The diver breathes from the tanks through a hose. A device called a *demand regulator* supplies the amount of air required. Scuba divers also use a mask and fins.

The most common type of scuba equipment, called *open circuit* scuba, uses air. The diver breathes air from the tank, and the exhaled air is released into the water. *Closed circuit* equipment, also called a *rebreather,* uses oxygen or a mixture of oxygen and other gases. It filters out the carbon dioxide and other harmful gases from the exhaled gas. More oxygen is added automatically. This action enables the diver to breathe the same air again and again.

Surface-supplied diving involves wearing a waterproof suit and a helmet. A diver gets air or breathing gas

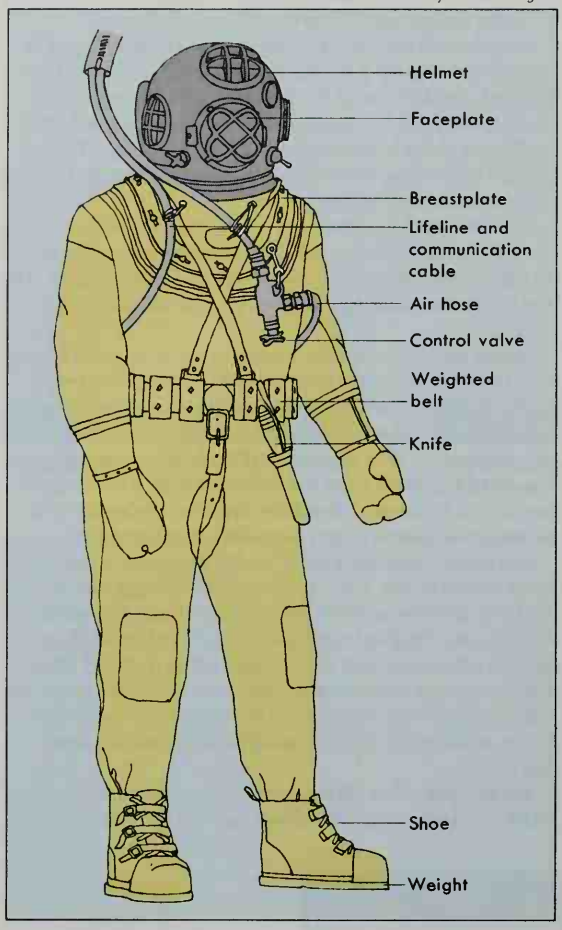
Perry Oceanographics, Inc.

An underwater diver drives a device into the ocean floor to obtain samples of the ocean bottom for research. The diver descended in a vehicle called a *submersible.* Two cables link the diver to the submersible. One supplies breathing gas, and the other enables the diver to communicate with people in the vehicle.

Surface-supplied diving equipment

In surface-supplied diving, a diver wears a waterproof suit and a helmet for protection against water pressure. Air or breathing gas travels through a hose connected to air pumps on a boat.

WORLD BOOK illustration by David Cunningham



through a hose connected to air pumps on a boat. Most deep diving is surface supplied. Divers wear many kinds of helmets and suits. Some wear heavy helmets and canvas suits. Lightweight fiberglass helmets and special diving masks are replacing older helmets made of copper. In addition to hoses that supply breathing gas, other hoses and wires may supply hot water to warm the diving suit, electricity or high-pressure air to operate power tools, and gases used for welding torches.

Diving in vehicles. There are several kinds of diving vehicles. These vehicles keep divers dry, warm, and at surface pressure.

Some divers wear metal suits called *articulated armor.* These suits cover the entire body. Like diving vehicles, articulated armor provides protection against pressure, but it enables the diver to move about more freely. Some types of articulated armor permit the diver to descend and ascend without the aid of cables.

Submarines are the largest diving vehicles. Most submarines are warships that carry powerful weapons. For more information about these ships, see **Submarine.**

Submersibles have extremely strong hulls and can descend much deeper than submarines can. Unmanned submersibles, which are operated using a cable, can descend to about 20,000 feet (6,100 meters). Manned submersibles can descend to about 21,000 feet (6,500 meters). Submersibles are used for research and other purposes.

The first submersibles, including the *bathysphere* and the *benthoscope,* were ball-shaped chambers with viewing *ports* (windows). They were lowered on cables from ships. Modern submersibles have motors and propellers and can maneuver independently. Some receive electric power through cables from the surface, but each carries its own supply of air. Some of these vehicles have external mechanical arms called *manipulators,* which can pick up objects from the ocean floor. Submersibles also have cameras and floodlights that enable scientists to photograph objects and organisms at depths where sunlight never penetrates.

Some types of submersibles carry tanks of gasoline, oil, or a foam composed of tiny glass bubbles. Such light substances help make the craft *buoyant* (able to float). Tanks filled with air, such as those used in submarines, would be crushed by the pressure at great depths. To descend, some of the buoyancy substance is released and replaced by water, which gives the craft additional weight. To ascend, the craft is lightened by dropping pieces of iron carried for this purpose. Some types of submersibles also use propellers when descending or ascending. A submersible called a *bathyscaph* consisted of a steel sphere attached to the bottom of a cigar-shaped hull filled with gasoline. Gasoline is lighter than water and so it gave the craft buoyancy. In 1960, the bathyscaph *Trieste* made the deepest dive ever recorded. It descended 35,800 feet (10,910 meters) into the Pacific Ocean. See **Bathyscaph.**

Dangers of underwater diving

There is greater pressure underwater than on land. Pressure increases by almost half a pound per square inch (0.04 kilogram per square centimeter) for each foot (30 centimeters) of depth. For example, the pressure on a diver 33 feet (10 meters) beneath the surface is twice as great as the air pressure at the surface. An ambient diver may be injured if the pressure in the lungs and other air spaces in the body does not equal the water pressure. Such an injury is called *barotrauma* or *squeeze.*

During ascent, the pressure in the lungs must be kept equal to the decreasing water pressure. Otherwise, a serious condition called *air embolism* may result. An ambient diver breathes more molecules of air underwater than on land because the air breathed underwater is compressed. When the diver rises to the surface, the air in the lungs expands because of the lesser pressure. If the air cannot be exhaled, it will tear the lungs and force air bubbles into the blood. These bubbles can block the flow of blood and cripple or even kill the diver. Air embolism can be prevented by breathing naturally and ascending slowly.

A condition known as the *bends* or *decompression sickness* occurs when nitrogen bubbles form in the blood. Nitrogen gas makes up more than three-fourths of the air breathed by human beings. An ambient diver who breathes compressed air absorbs large amounts of

nitrogen into the blood. As the diver ascends, this excess nitrogen is exhaled. But if the diver ascends too quickly, bubbles of nitrogen gas form in the blood. The nitrogen bubbles can block the flow of blood and cripple or kill the diver. A diver can avoid the bends by rising slowly enough to allow the excess nitrogen to be eliminated through breathing.

A chart called a *decompression table* tells a diver how long he or she can stay at a certain depth without absorbing a dangerous amount of nitrogen. It also tells how slowly the diver must ascend to avoid the bends. A person who has air embolism or the bends should be put into a *recompression chamber* immediately. In this chamber, the diver is returned to a pressure that compresses the bubbles so that the gas dissolves back into the blood. The pressure is then reduced in stages.

Divers breathing air at extreme depths may also suffer a kind of drugged effect called *nitrogen narcosis.* This condition causes a loss of the ability to reason. Nitrogen narcosis occurs most frequently at extreme depths. To avoid it, divers may breathe a gas mixture that contains helium instead of nitrogen.

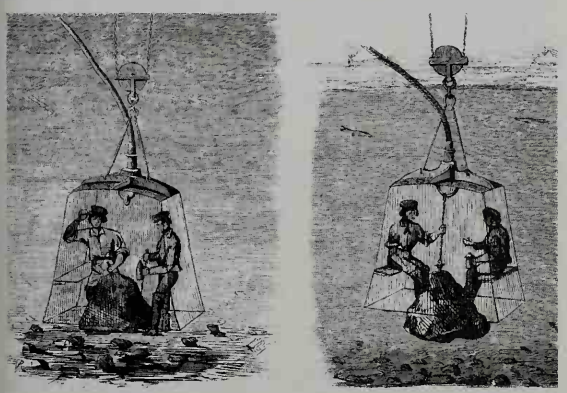
A diver who breathes 100 percent oxygen at great depths may suffer oxygen poisoning. The diver grows dizzy, vomits, and may have convulsions. Gas mixtures high in oxygen can also cause oxygen poisoning.

History

Breath-hold divers dived for shells in the Mediterranean Sea as early as 4500 B.C. Ancient Greek and Roman divers sought pearls, sponges, and shells.

Divers in the Persian Gulf used goggles made of polished clear tortoise shell to see clearly underwater as early as A.D. 1300. In the early 1930's, Guy Gilpatric, an American diver, became one of the first to use rubber goggles with glass lenses. By the mid-1930's, face masks, fins, and snorkels had come into use.

The first devices that enabled people to breathe underwater were called *diving bells.* These bell-shaped hulls have been used since ancient times. Diving bells are open to the water at the bottom and get air from the surface through a hose. The air pressure that exists within the bell keeps water out of the device.



Culver

Diving bells of the 1800's could be used to remove rocks from rivers. These two pictures show a rock being attached to a diving bell and then raised to the surface. Diving bells are open at the bottom. The air pressure within the bell keeps the water out.

In 1715, John Lethbridge, an English diver, designed a wooden and leather diving suit that was used in salvage work. The suits used for helmet diving today are based on a diving suit that was introduced in 1837 by Augustus Siebe, a German engineer who was living in England.

Independent breathing devices for diving appeared during the late 1800's and early 1900's. The first safe and simple device, the *aqualung,* was invented in 1943 by two Frenchmen, Jacques-Yves Cousteau, a naval officer, and Émile Gagnan, an engineer.

The development of enclosed diving vehicles expanded the range of underwater activity. Otis Barton of the United States designed the bathysphere. In 1930, he and William Beebe, an American naturalist, made the first dive in it. The Swiss physicist Auguste Piccard designed the first bathyscaph in 1948.

Experimental underwater *saturation habitats* were developed in the 1960's. These stations consist of one or more buildings erected on the ocean floor. They have been tested at depths ranging from 30 to more than 600 feet (9 to 180 meters). Compartments inside the buildings are filled with compressed breathing gas. Divers may live there for weeks. They leave the station daily to explore or work. By staying underwater, the divers avoid the need to undergo decompression every day. The first saturation habitat was built off the coast of France in 1962 by Cousteau. During the 1960's and 1970's, many such structures were built. Arthur H. Ullrich, Jr.

Related articles in *World Book* include:

Ballard, Robert Duane
Beebe, William
Bends
Cousteau, Jacques-Yves
Earle, Sylvia Alice
Marine biology
Ocean (Exploring the ocean)
Piccard (family)
Skin diving
Spearfishing
Submarine

Additional resources

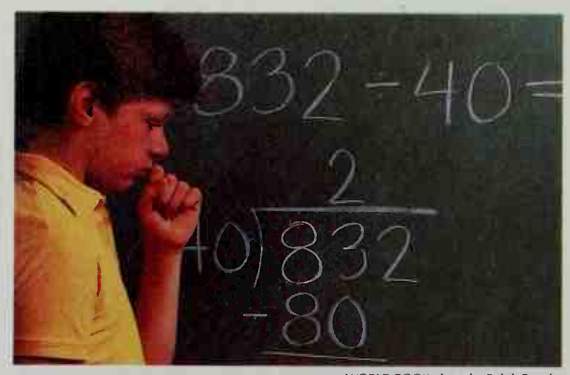
Bane, Michael. *Diving on the Edge: A Guide for New Divers.* Lyons Pr., 1998.

Broad, William J. *The Universe Below: Discovering the Secrets of the Deep Sea.* Simon & Schuster, 1997.

Division is a unit in a nation's armed forces that is larger than a brigade and smaller than a corps. The term *division* usually refers to a ground force consisting of two or more brigades or regiments, plus supporting units. In the United States Army, a division has about 15,000 soldiers. In other countries, divisions are smaller and may operate in a group with many other divisions. In still other countries, a division is an administrative headquarters to which brigades are attached.

Divisions are generally classified by the combat arm within them. In the United States Army, there are five kinds of divisions: (1) airborne, (2) air assault, (3) *armored* (tank), (4) mechanized infantry, and (5) infantry, which includes light infantry. A division has from 6 to 15 battalions organized into 3 brigades, plus artillery, control, engineer, *reconnaissance* (information gathering), and supply units. A United States Marine Corps division has about 19,000 marines. Marine divisions are organized into three regiments and combat and service support units. A U.S. Air Force air division includes two or more *wings.* A wing is a mobile unit that can operate independently. Joel D. Meyerson

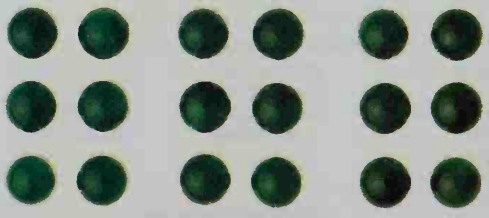
See also **Army** (The organization of armies); **Army, United States** (table: Army levels of command).



WORLD BOOK photo by Ralph Brunke

A division problem at the chalkboard tests a student's knowledge of one of the most basic processes of mathematics.

Division is a way of separating a group of things into equal parts. Suppose you have 18 marbles and you want to share the marbles with two friends. You want each of you to end up with the same number of marbles. To find out how many marbles each of you would get, you can count out the marbles into three equal groups. Each group has six marbles. So each of you would get six marbles as shown below. Separating a group of 18



things into three equal parts of 6 things is an example of division.

Division is one of the four basic operations in arithmetic. The others are addition, subtraction, and multiplication. You must learn how to add, subtract, and multiply before you begin to study division.

Learning to divide

Once people learned division only by memorizing. Most teachers now agree that the best way to learn division is by understanding. You can learn to understand division without much difficulty.

Division terms

Dividend. In $32 \div 8 = 4$, 32 is the dividend.

Division fact is a division in which the divisor and quotient are whole numbers not larger than 9. For example, $42 \div 7 = 6$ is a division fact.

Divisor. In $32 \div 8 = 4$, 8 is the divisor.

Long division is a method of dividing numbers in which the work is written out.

Quotient. In $32 \div 8 = 4$, 4 is the quotient.

Remainder is any amount left over after a division operation has been completed. The remainder is always less than the divisor.

Short division is a method of dividing numbers in which much of the work is done mentally.

Writing division. One way of separating a group into equal parts is by counting it out into equal parts. But there is a much easier way to divide. To find how many groups of 3 there are in 12, you can subtract 3 from 12 until nothing is left:

$$\begin{array}{r} 12 \\ -3 \\ \hline 9 \end{array} \quad \begin{array}{r} 9 \\ -3 \\ \hline 6 \end{array} \quad \begin{array}{r} 6 \\ -3 \\ \hline 3 \end{array} \quad \begin{array}{r} 3 \\ -3 \\ \hline 0 \end{array}$$

This shows that there are four 3's in 12.

Each basic operation in arithmetic is indicated by a special symbol. The symbol for division is ÷. The statement $12 \div 3 = 4$ means that when 12 things are separated into groups of three, there are four such groups. Or, that there are four 3's in 12. It can also mean that when 12 things are separated into three equal groups, there are four things in each group. People who know division usually read $12 \div 3 = 4$ as "12 divided by 3 is 4." A problem in division also may be written this way:

$$3\overline{)12}\ 4$$

The parts of a division problem have special names. The number being divided is called the *dividend*. The number by which the dividend is divided is the *divisor*. The answer, or result, of the division is the *quotient*.

$$\begin{array}{rl} & 4 \quad \text{Quotient} \\ \text{Divisor} & 3\overline{)12} \quad \text{Dividend} \end{array}$$

Another way of writing a problem in division is the form used in writing fractions (see **Fraction**):

$$\frac{12}{3} = 4$$

Division facts. By using subtraction, you discovered that there are three equal groups of 4 things in a group of 12. Or, $12 \div 3 = 4$. This is a *division fact*. You can find all the division facts by using subtraction.

The 64 division facts

$2\overline{)4}$	$3\overline{)6}$	$4\overline{)8}$	$5\overline{)10}$	$6\overline{)12}$	$7\overline{)14}$	$8\overline{)16}$	$9\overline{)18}$
$2\overline{)6}$	$3\overline{)9}$	$4\overline{)12}$	$5\overline{)15}$	$6\overline{)18}$	$7\overline{)21}$	$8\overline{)24}$	$9\overline{)27}$
$2\overline{)8}$	$3\overline{)12}$	$4\overline{)16}$	$5\overline{)20}$	$6\overline{)24}$	$7\overline{)28}$	$8\overline{)32}$	$9\overline{)36}$
$2\overline{)10}$	$3\overline{)15}$	$4\overline{)20}$	$5\overline{)25}$	$6\overline{)30}$	$7\overline{)35}$	$8\overline{)40}$	$9\overline{)45}$
$2\overline{)12}$	$3\overline{)18}$	$4\overline{)24}$	$5\overline{)30}$	$6\overline{)36}$	$7\overline{)42}$	$8\overline{)48}$	$9\overline{)54}$
$2\overline{)14}$	$3\overline{)21}$	$4\overline{)28}$	$5\overline{)35}$	$6\overline{)42}$	$7\overline{)49}$	$8\overline{)56}$	$9\overline{)63}$
$2\overline{)16}$	$3\overline{)24}$	$4\overline{)32}$	$5\overline{)40}$	$6\overline{)48}$	$7\overline{)56}$	$8\overline{)64}$	$9\overline{)72}$
$2\overline{)18}$	$3\overline{)27}$	$4\overline{)36}$	$5\overline{)45}$	$6\overline{)54}$	$7\overline{)63}$	$8\overline{)72}$	$9\overline{)81}$

It is important to learn the division facts so well that you can use them automatically. The facts are useful themselves. They are also necessary in learning how to divide larger numbers quickly and accurately.

Long division

Long division is a method that can be used to divide large numbers. In long division, you write out the work carefully.

Suppose you want to find out how many 3's there are in 79, or 79 ÷ 3. Instead of subtracting one 3 at a time, you can shorten your work by subtracting several 3's at once. To begin, you might subtract five 3's, or 15, each time:

79	64	49	34	19	4
−15	−15	−15	−15	−15	−3
64	49	34	19	4	1

All together, you subtracted 5 + 5 + 5 + 5 + 5 or twenty-five 3's from 79, leaving 4. You cannot subtract five more 3's, but you can subtract one more 3, leaving a *remainder* of 1. Thus, there are 25 + 1 or twenty-six 3's in 79 with 1 left over.

Subtracting five 3's at a time shortened your work. Next, you might try subtracting ten 3's, or 30, each time:

79	49	19	4
−30	−30	−15	−3
49	19	4	1

This time, you subtracted 10 + 10 + 5 + 1 or twenty-six 3's from 79, and had 1 left as a remainder. A better form to use is this:

3/79		
−30	10	The number of 3's
49		
−30	10	subtracted are re-
19		
−15	5	corded in this column.
4		
−3	1	
Remainder → 1	26	The total number of 3's subtracted.

After some practice, you might subtract twenty 3's and then six 3's:

26		← The result is written
3/79		
−60	20	above the dividend
19		
−18	6	to complete the form.
1	26	

To gain further practice in long division, you might now try to find out how many 21's there are in 891, or 891 ÷ 21. First, you must decide how many 21's you will subtract at a time. Ten 21's, or 210, might prove to be useful. Using 10's, 100's, or 1,000's in multiplying the divisor makes division much easier.

42		
21/891		
−210	10	Number of 21's
681		
−210	10	subtracted.
471		
−210	10	
261		
−210	10	
51		
−21	1	
30		
−21	1	
Remainder → 9	42	

When you have subtracted four 210's or forty 21's, you find that the remainder, 51, is too small to subtract ten more 21's. You can, however, subtract one 21 at a time. This finally gives you 10 + 10 + 10 + 10 + 1 + 1 or forty-two 21's in 891, with a remainder of 9.

You could have used twenty 21's, or 420, as your first unit.

42		
21/891		
−420	20	Number of 21's
471		
−420	20	subtracted.
51		
−42	2	
Remainder → 9	42	

One last example will illustrate further the process of long division. Suppose you want to know how many 37's there are in 12,526, or 12,526 ÷ 37. Once again you must decide how many 37's to subtract at one time.

338		
37/12526		
−7400	200	Number of 37's
5126		
−3700	100	subtracted.
1426		
−1110	30	
316		
−185	5	
131		
−111	3	
Remainder → 20	338	

You may have to experiment on a sheet of scrap paper to find the units that you can use to solve the problem easily. You can use even larger units than 200.

338		
37/12526		
−11100	300	Number of 37's
1426		
−1110	30	subtracted.
316		
−296	8	
Remainder → 20	338	

Many persons use a form for long division even shorter than those outlined above. The three steps look like this:

```
   3          33          338
37/12526   37/12526    37/12526
  111        111         111
  ---        ---         ---
   14         142         142
              111         111
              ---         ---
               31         316
                          296
                          ---
                           20
```

This form does the same things that have been discussed above, but by a different method. It does not illustrate the process so well to a beginner.

When using this shorter form, it helps to notice that in all these examples you write the answer (quotient) above the proper places in the dividend. That is, when you subtract a number of 100's, you record the number of 100's above the 100's place in the dividend.

Remainders in division. There is often a remainder when you have completed a problem in division. What you do with this remainder depends on the kind of problem. If you want to know how many 3's there are in 79, you might have had 79¢ to spend on three-cent postage stamps. You would find that you could buy 26 stamps and have 1¢ left.

If you wanted to share 79 apples among three persons, you would also find that there are twenty-six 3's in 79 and a remainder of 1. This means that each person gets 26 apples and there is one left to share. If the sharing is to be absolutely equal, you would have to cut the remaining apple into three equal parts. Each person would receive $26\frac{1}{3}$ apples.

These examples show that what is done to a remainder depends on the problem. In some cases, further division into fractional parts is indicated. In other cases, the remainder merely tells how many are "left over."

Division of decimal fractions. You can also use long division to divide numbers that include decimal fractions. The statement 78.35 ÷ 3.6 is this kind of problem. In order to understand division of decimal fractions, you must learn an interesting feature of division.

You know that 15 ÷ 3 = 5 is a division fact. What would happen if both the 15 and 3 were multiplied by 10? That is, what is the result of dividing 150 by 30? Long division will show you that this quotient is also 5. Thus, 15 ÷ 3 = 5, and 150 ÷ 30 = 5. Similarly, 72 ÷ 6 = 12 and 720 ÷ 60 = 12. If the 72 and 6 are multiplied by 100, the quotient of 7,200 ÷ 600 is also 12. These examples illustrate a general rule: *multiplying both the dividend and divisor by 10, 100, 1,000, or any other nonzero number, does not change the quotient.*

This rule can be used to divide 78.35 by 3.6. Both 78.35 and 3.6 can be multiplied by 10. Thus, 78.35 × 10 = 783.5 and 3.6 × 10 = 36. The quotient of 783.5 ÷ 36 will be the same as the quotient of 78.35 ÷ 3.6. But the decimal points now have new positions. A useful device is to use a caret mark (^) to indicate the new position of the decimal points. The decimal point in the quotient will appear directly above the caret mark in the dividend.

$$3.6\text{^}\overline{)78.3\text{^}5}$$

This shows that 78.35 and 3.6 have both been multiplied by 10. Sometimes it is necessary to multiply the dividend and divisor by 100, 1,000, or some larger multiple of 10. For example, 25.773 ÷ 17.94 should be multiplied by 100:

$$17.94\text{^}\overline{)25.77\text{^}3}$$

You should multiply the dividend and divisor by a multiple of 10 large enough to change the divisor into a *whole number,* or a number that does not include a decimal fraction.

For every division problem with a remainder of zero, there is a corresponding multiplication problem. The two numbers that are multiplied are the quotient and divisor in the division problem. For example:

$$3.25 \div 1.3 = 2.5$$
$$1.3 \times 2.5 = 3.25$$

Experience with such problems has resulted in two rules. In multiplication, the number of decimal places in the *product* (answer to the multiplication problem) is the sum of the number of decimal places in the numbers that were multiplied. In division, the number of decimal places in the quotient is the number of decimal places in the dividend minus the number of decimal places in the divisor. If the divisor is a whole number, you can ignore the decimal point in the dividend while you are working the problem. When you get a number for the quotient, put as many decimal places in the quotient as there are in the dividend. Because the divisor has no decimal places, none must be subtracted from the number in the dividend.

In division problems, you often have to find the quotient to the nearest tenth, hundredth, and so on. You can do this easily. After you have placed the caret marks in the divisor and dividend, use just as many digits to the right of the dividend's caret mark as the number of decimal places wanted in the answer. Sometimes it is necessary to add zeros to the dividend. For example, you must first change $3.6\overline{)78.35}$ to $3.6\text{^}\overline{)78.3\text{^}5}$ to make the divisor a whole number. Suppose the quotient must be correct to the nearest hundredth. Then you must add a zero to the dividend, making it $78.3\text{^}50$.

```
      21.76
3.6^)78.3^50
    -72 0 00      2000
     6 3 50
    - 3 6 00       100
     2 7 50
    - 2 5 20        10
       2 30
      - 2 16         6
         14       2176
```

You do not have to do anything with the remainder, because the problem asked you to be accurate only to the nearest hundredth. If the remainder is more than half of the divisor, then the digit in the divisor that is farthest to the right is increased by one. When the remainder is exactly half of the divisor, it is common to add one to the rightmost digit of the divisor if doing so will make it an

even number (number that can be divided by two without a remainder).

Short division

When dividing by a one-digit number such as 7, you can do some of the work in long division without writing it down. Division of this kind, which is usually done in the mind rather than on paper, is called *short division.* The method is the same as in long division, but you do the work mentally.

Long Division		*Short Division*
212		212 R(emainder) 1
4/849		4/849
−800	200	
49		
−40	10	
9		
−8	2	
1	212	

The only difference between these two examples is that in short division you do the work mentally and indicate the remainder next to the quotient. The letter *R* is often used to mean *Remainder.* In this example, you first see that you can subtract two hundred 4's from 849. You write the 2 in the 100's place over the 8 in the dividend. Next, you can subtract ten 4's from the remaining 49. You write the 1 in the 10's place over the 4 in the dividend. Finally, you can subtract two 4's from the remaining 9. You write the 2 in the 1's place over the 9 in the dividend. You show the remainder to the right of the quotient.

In more difficult problems in short division, you must use a new device. The problem 415 ÷ 7 will show this.

$$7\overline{)415}\quad 5$$

In solving this problem, your first step is to subtract fifty 7's or 350, which is thirty-five 10's. Write the 5 (for 50 or five 10's) over the 1 in the dividend. You do the subtraction mentally. Thirty-five 10's subtracted from forty-one 10's is six 10's. You write a little 6 to the left of the 5 in the dividend.

$$7\overline{)41^{6}5}\quad 5$$

Now you are dividing six 10's and 5, or 65, by 7. You can subtract nine 7's or 63 from 65, leaving a remainder of 2.

$$7\overline{)41^{6}5}\quad 5\ 9 \qquad \text{R } 2 \qquad \text{or } 59\tfrac{2}{7}$$

It is useful to see how this process is derived from long division.

59		5 9	R 2
7/415		7/41⁶5	
−350	50		
65			
− 63	9		
2			

Another example is 7,536 ÷ 9. As in the case of long division, you must decide how many 9's you can subtract at one time.

$$9\overline{)75^{3}3^{6}6}\quad 8\ 3\ 7 \qquad \text{R } 3 \qquad \text{or } 837\tfrac{3}{9} \text{ or } 837\tfrac{1}{3}$$

First, you subtract eight hundred 9's, or 7,200. You write the 8 (for eight 100's or 800) over the 5 in the dividend. Mentally you subtract 72 (hundreds) from 75 (hundreds): 75 − 72 = 3. You write a little 3 to the left of the 3 in the dividend to keep the three 100's in the work. From this new figure of 336, you can subtract thirty 9's or 270. You write the 3 for the thirty 9's over the 3 in the dividend. Next, 33 − 27 = 6. You write a little 6 to the left of the 6 in the dividend to keep the six 10's in the work. From this new figure of 66, you can subtract seven 9's, or 63. You write the 7 for the seven 9's over the 6 in the dividend. Finally, 66 − 63 = 3. You indicate the remainder of 3 to the right of the quotient. After you have had some practice, you will be able to leave out the little numbers as reminders of figures that must be included in the work. You will soon be able to remember these numbers in your head.

How to check division

You will be wise to check the answer to a division problem to be sure you have solved it correctly.

Rounding off. One way to check is to see whether or not the quotient is a sensible answer. You can estimate a quotient by rounding off the dividend and divisor. To estimate the quotient of 158 ÷ 76, you can round off 158 to 160 and 76 to 80. Because 160 ÷ 80 = 2, the quotient of 158 ÷ 76 should be about 2. To estimate the quotient of 5,124 ÷ 36, you can round off 5,124 to 5,000 and 36 to 50. You can see that 5,000 ÷ 50 = 100, and 5,000 ÷ 25 = 200. Thus, the quotient of 5,124 ÷ 36 should be somewhere between 100 and 200. Estimating the quotient will help you decide whether your answer is sensible.

Checking by multiplication. Another way of checking a quotient is to multiply the quotient by the divisor to see if the product is the dividend. If you have multiplied correctly, this method will catch any error. This is because multiplication is the opposite of division.

13	13
24/312	×24
	52
	26
	312

The next example shows how to use the remainder in checking by multiplication:

42	R 7	42
21/889		×21
		42
		84
		882
		+ 7 R
		889

The quotient is multiplied by the divisor, and the remainder is added to the product.

Four key division ideas

Here are four important rules to remember for solving division problems.

1. Remember that division means breaking up a number into smaller equal groups. The divisor can show the size of these groups or the number of groups.
2. Learn the division facts so well that you do not have to stop and figure them out each time. You will use the division facts constantly in everyday arithmetic, and will need to know them to divide larger numbers.
3. Remember the method for dividing larger numbers used in long division. In long division, subtract the divisor from the dividend as many times as possible in a single step. In this way, you can reduce the number of steps in long division.
4. Always check the answer after finishing a division problem. You can do this by estimating or by multiplying the quotient by the divisor and adding any remainder.

Fun with division

Space is a game played with cards much like those used in bingo. Each card has a square drawn on it. The square is subdivided into 25 smaller squares. The letters S P A C E are written across the top of the card. The squares are filled in with any arrangement of the numerals from 1 to 9. Each square has one number, except the one in the center which is marked *F* for "free." Each card should have a different pattern of numerals on it. Each player has a card and a set of small markers. The leader of the game calls out questions on the division facts, for example, "Under *A*, the 4's in 20." There are five 4's in 20. If the players have the number 5 under *A* on their card, they cover the number. The first player to completely cover all numbers in a row, a column, or a diagonal calls out "Space!" and wins the game. The leader keeps a record of the division facts called and uses this record to check the winner's card. For a new game, exchange the cards among the players.

S	P	A	C	E
2	1	3	4	5
3	4	5	5	3
5	6	F	6	4
6	8	6	7	6
8	9	8	9	8

Divide-down is an arithmetic version of a spelldown. The players are divided into two teams. Each player is asked one of the division facts, such as "how many 6's in 42?" If the players answer correctly, they stay in the game. If they miss, they must leave the game. When all the members of one team have missed, the other team is declared the winner.

Nadine L. Verderber

Related articles in *World Book* include:

Addition
Algebra (Division)
Arithmetic
Decimal system
Fraction
Multiplication
Numeration systems
Subtraction

Outline

I. Learning to divide
A. Writing division
B. Division facts
II. Long division
A. Remainders in division
B. Division of decimal fractions
III. Short division
IV. How to check division
A. Rounding off
B. Checking by multiplication
V. Four key division ideas
VI. Fun with division

Practice division examples

1. $4\overline{)56}$	4. $6\overline{)522}$	7. $3\overline{)1008}$	10. $47\overline{)6281}$	13. $3.14\overline{)25.60}$
2. $7\overline{)105}$	5. $9\overline{)387}$	8. $8\overline{)984}$	11. $326\overline{)10457}$	14. $.06\overline{)9.87}$
3. $5\overline{)625}$	6. $2\overline{)1146}$	9. $23\overline{)483}$	12. $29\overline{)1201}$	15. $1.26\overline{).00882}$

16. Miss Smith's class at school is going to visit the local newspaper. Some of the mothers have offered to drive. There are 35 children in the class, and each car can take 5 children. How many cars will be needed for the trip?

17. A certain kind of candy bar costs 6¢ each. How many of these candy bars can Sue buy with 48¢?

18. There are 7 days in a week. How many weeks are there in one year (365 days)?

19. Four boys wish to share equally 64 pieces of candy. How many pieces should each boy get?

20. Tom rides his bicycle at a speed of 6 miles an hour. At this rate, how many hours will it take him to ride 15 miles?

21. Jane's class in school wants to buy some sketchbooks that cost 23¢ each. Her class has $5.85 to spend for books. How many sketchbooks can Jane's class buy?

22. An airplane travels at the rate of 565 kilometers an hour. How long will it take to fly 1,320 kilometers?

23. Bill and his father went on a trip in their car. They traveled 613.9 kilometers in 10 hours, 18 minutes. What was their average rate of speed?

24. Mary's mother rents a house for $2,520 a year. How much rent would she have to pay for one month?

Answers to the division examples

1. 14	5. 43	9. 21	13. 8.15	17. 8 bars	21. 25 books and 10¢ left
2. 15	6. 573	10. 133 R 30	14. 164.5	18. 52 weeks and 1 day	22. 2 hrs. and about 20 min.
3. 125	7. 336	11. 32 R 25	15. .007	19. 16 pieces	23. 59.6 kilometers an hour
4. 87	8. 123	12. 41 R 12	16. 7 cars	20. $2\frac{1}{2}$ hours	24. $210 a month

Divorce is the legal ending of a marriage. The laws of most nations permit divorce only under certain circumstances. Divorce is restricted chiefly because it breaks up a family, the basic unit of society. Some countries, including the Philippines, prohibit divorce.

Most men and women who seek a divorce do so because they cannot solve certain problems in their marriage. Such problems may include differences in goals, financial difficulties, or a poor sexual relationship. A person seeking a divorce generally must appear in court to explain why he or she wants to end the marriage. A judge then decides whether to grant a divorce. In general, a divorced person may remarry.

Divorce differs from *annulment,* in which a court declares that a marriage has been invalid from its start. A person whose marriage has been annulled may remarry. Divorce also differs from *legal separation,* in which a court authorizes *spouses* (a husband and wife) to live apart. Legally separated spouses may not remarry.

Divorce is a sizable problem in the United States and many other countries. Each year, more than a million couples divorce in the United States. In many of these divorces, couples have children under 18 years old. About a fourth of the children in the United States live with only one parent. Divorce affects many young children deeply. But many experts believe that living with one parent is less harmful to a child than living with both parents in an unhappy environment.

Most divorced men and women remarry, and many such marriages are successful. However, second marriages present special problems of adjustment, especially for couples who have children from former marriages. Families that include children from one or more previous marriages are called *stepfamilies* or *reconstituted families.* Such families have become more and more common as the divorce rate rises.

The first written divorce regulations were incorporated in the ancient Babylonian *Code of Hammurabi.* Many early societies permitted only the husband to get a divorce. The early Christians taught that marriage was permanent until death, and abolished divorce in the areas they governed. They also set up special church courts to handle marriage matters. Starting in the A.D. 1500's, Protestant reformers successfully worked to place matters of marriage and divorce under government jurisdiction.

Divorce rarely occurred in the American Colonies. Some colonies made no provision for divorce at all. But by the mid-1800's, almost every state had a divorce law. The divorce rate has increased significantly since then, particularly in the late 1900's.

Grounds for divorce

Modern divorce laws have developed largely from religious rules. For example, in Australia, Canada, New Zealand, the United Kingdom, and the United States, divorce laws have been based on Christian tradition. Until the mid-1900's, divorce in these countries was available only to an "innocent" party. Divorces would be granted only if the other spouse committed a *matrimonial offense,* such as adultery, cruelty, or desertion.

In the 1960's, many people called for a more liberal approach to divorce. They believed that the fault did not necessarily lie with just one spouse, and that it was pointless to maintain an unsuccessful marriage.

In the United States. Each U.S. state has its own divorce laws. But all states recognize a divorce granted by the state in which one or both of the spouses are legal residents. State laws set forth the *grounds for divorce*—that is, the reasons for which a divorce may be granted. Depending on the kind of grounds, a divorce can be classified as a *fault divorce* or a *no-fault divorce.*

Fault divorce. Courts traditionally have granted divorces chiefly on *fault grounds.* These grounds vary, but the most common ones are adultery, alcoholism, desertion, drug addiction, failure to support, imprisonment for felony, and mental or physical cruelty.

A person seeking a divorce on a fault ground must prove that his or her spouse committed the fault. For example, a woman seeking a divorce on the ground of desertion must prove that her husband deserted her. The husband may *contest* (argue against) the divorce action. If the wife's proof is accepted, the judge grants her a divorce. But if the husband can prove his wife consented to or encouraged his action, the judge may refuse to grant a divorce. The judge also may rule against the wife if the husband can prove she committed a legal fault. Many fault divorces are uncontested.

No-fault divorce. A person seeking a divorce on a *no-fault ground* does not try to prove that the spouse committed a wrong. The person simply testifies that the marriage has failed. In many cases, the judge grants a divorce even if the person's spouse objects.

In 1969, California became the first state to enact a no-fault divorce law. This law provides only two grounds for divorce. These grounds are (1) *irreconcilable differences*—that is, disagreements that cannot be settled and have led to the breakdown of the marriage; or (2) the incurable insanity of one spouse. Generally, a person may not tell the judge about any misconduct of the spouse.

Some states have replaced all traditional grounds for divorce with the single no-fault ground of marriage breakdown. Other states have added this to their traditional grounds. Several states allow a couple to get a divorce on the ground that they have been separated for a certain period. Some states grant divorce on the ground of *incompatibility* (being unable to get along together).

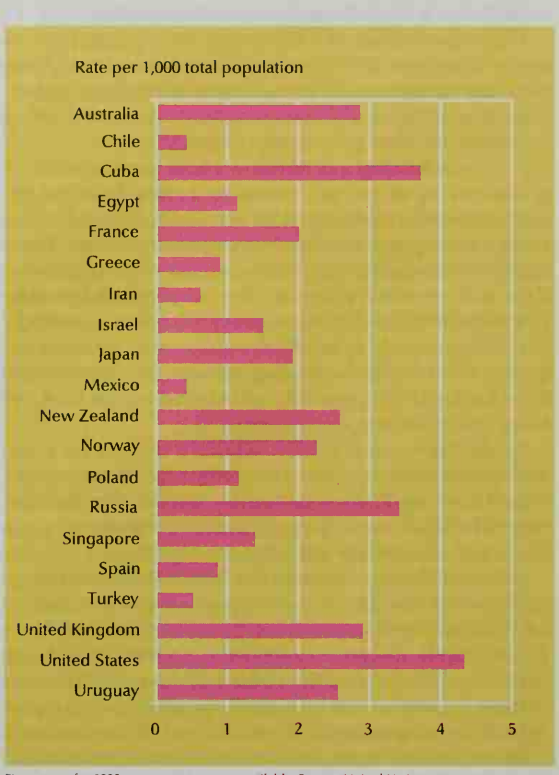
People who favor no-fault divorce argue that many marriages fail for reasons other than one spouse's misconduct. Therefore, they argue, a divorce should be granted for reasons other than a fault. In addition, these people believe that relations between spouses remain friendlier in no-fault cases than in fault cases.

Supporters of no-fault laws also point out that traditional divorce laws lead many couples to lie in court. For example, a couple may want a divorce because they cannot get along. But they live in a state that grants divorces only on a few fault grounds. The couple might lie to the judge that one spouse was cruel to the other.

A related argument for no-fault laws is that traditional divorce laws lead some people to seek a divorce in another state. For example, a person living in a traditional divorce state may go to a no-fault divorce state that has a short residency requirement. After living in this state for the required period, the person might falsely claim to be a permanent resident. He or she would then obtain a divorce and return to his or her own state. If the spouse disputes the validity of the divorce, a court may decide that residence was not truly established in the state that

Divorce rates for selected countries

This graph shows the number of legal divorces in a year for every 1,000 people in selected countries. Factors accounting for differences in divorce rates among countries include divorce laws, cultural acceptance, religious beliefs, and economic opportunities for women.



Figures are for 1998 or most recent year available. Source: United Nations.

granted the divorce. As more states liberalize their laws, fewer people seek divorce in such a state as Nevada, which has a residency requirement of just six weeks.

Some people oppose no-fault divorces because they think that such divorces are too easy to obtain. They fear that judges may grant a divorce to anyone who says the marriage has broken down, whether it has or not. Others believe restrictions should be added to no-fault laws to prevent premature or unnecessary divorces. In some states, courts direct couples planning divorce to consult a marriage counselor. Some states require a waiting period to give a couple time to reconsider their decision.

The divorce process may be simpler under no-fault laws than under fault laws. Therefore, in some no-fault states, some couples can obtain a divorce without hiring lawyers. Some judges oppose this practice, called *do-it-yourself divorce,* because they believe a lawyer is needed to protect the rights of spouses and children.

In other countries. In Australia, Canada, New Zealand, and the United Kingdom, spouses may obtain a divorce if they show proof of an irreversible breakdown of the marriage. In India, most people follow Hinduism, which traditionally does not allow divorce. But a civil law of 1955 allowed for divorce among Hindus. Other religious groups in India, such as Muslims, Parsis, and Sikhs, have other divorce laws. Under some interpretations of Islamic law, for example, a man may divorce his wife by saying the word *talaq* (divorce) three times.

Divorce provisions

A husband and wife planning a divorce must make arrangements for child custody and support, division of property, and, in some cases, financial support of a spouse. They may reach agreement on these arrangements through their lawyers. If the judge considers the agreement fair, the judge approves it. If the spouses cannot agree, the judge decides on the arrangements.

Financial arrangements. In the past, the judge ordered many divorced men to pay considerable *alimony*—that is, money to maintain their ex-wives. They also had to give up some of their property and bear most of the responsibility for supporting their children. There were two chief reasons for this situation. First, many divorced women had no job outside the home and needed money to support themselves and their children. Second, traditional fault laws provided that the "guilty" spouse could not receive alimony. In many cases, the husband was the legally guilty spouse because his wife sued for the divorce, though both might have wanted it.

Today, courts base their decisions on financial arrangements mainly on the financial condition of each spouse. Judges realize that many women have the qualifications to work outside the home and need not be fully supported by their former husband. Therefore, if both spouses can earn enough income to support themselves, the court may order that no alimony, or *maintenance,* be paid. If the wife has a higher income than her husband, she may have to pay maintenance to him. The parents also may share responsibility for child support.

In addition, the court may divide a couple's property on the basis of financial circumstances. Under the *community property* laws of a few U.S. states, property acquired during a marriage belongs equally to both spouses. This property is divided equally in most cases.

Child custody arrangements. In the early and middle 1900's, judges granted custody of the children to the wife almost automatically in the majority of divorce cases. They believed that children should not be separated from the mother. Today, many judges realize that some children might be better off living with the father. Therefore, the court may grant custody to either parent. The judge also determines each parent's rights to visit the children. The judge may ask the children with which parent they would prefer to live. The judge usually gives custody of all the children of a marriage to one parent.

Some divorced parents return to court several times because one or both of them wants to challenge the child custody decision. If the court changes its decision, the children may have to leave the home of one parent and move in with the other. Such a move can harm children emotionally. As a result, some courts have become reluctant to move children unless they are in danger.

The divorce rate

Divorce rates have increased dramatically since the 1960's. Experts have suggested many reasons for this increase. (1) Divorce is more socially acceptable than it once was. (2) Many people expect more of marriage than earlier generations did, and so they may be more easily disappointed. (3) More high-paying jobs are open

to women. Thus, women are less economically dependent on their husbands than in the past. (4) Changes in divorce laws have made divorce easier to obtain.

The divorce rate is higher in the United States than in almost any other country. In general, cities have a higher divorce rate than rural areas. The rate also varies among different states and regions, partly because divorce laws and court practices differ. But the rates probably also differ because of variances in the cultural, economic, racial, and religious composition of the population. In general, people with nonprofessional jobs and those with low incomes have a higher divorce rate than people with professional jobs and those with high incomes. But one nonprofessional group—farmers—has an extremely low divorce rate. Most studies show that black couples and couples consisting of a black and a white have higher divorce rates than white couples do.

Of the three major religious groups in the United States, Roman Catholics have the lowest divorce rate and Protestants the highest. The Catholic Church holds that valid marriages cannot be dissolved. It allows its members to get a civil divorce to solve financial and child custody problems. But it does not believe such a divorce gives the right to remarry. If the church has annulled a marriage, the people involved may remarry (see **Annulment**). Judaism and most Protestant groups permit divorce. Some surveys show that Catholic-Protestant couples and Christian-Jewish couples have a higher divorce rate than couples of the same religion. But one study showed no difference in the divorce rate of Catholic-Protestant couples. Steven L. Nock

Related articles in *World Book* include:

Abandonment
Alienation of affections
Alimony
Community property
Desertion
Family (Challenges and opportunities)
Marriage
Parents Without Partners

Additional resources

McKay, Matthew, and others. *The Divorce Book.* 2nd ed. New Harbinger, 1999.
Riley, Glenda. *Divorce.* 1991. Reprint. Univ. of Neb. Pr., 1997.

Dix, Dorothea Lynde (1802-1887), led the drive to build state hospitals for people with mental illness in the United States. She also improved prison conditions. She traveled throughout the United States and Europe for this cause until she was 80. She gained the support of wealthy people, and of such distinguished educators and statesmen as Horace Mann and Charles Sumner.

Dix was born on April 4, 1802, in Hampden, Maine, but grew up in Massachusetts. She visited a Massachusetts house of correction in 1841 and was shocked by the treatment of the mentally ill. She asked the legislature to provide better care and began the reform in that state. During the American Civil War (1861-1865), she was superintendent of the U.S. Army nurses. Dix died in July 1887.

Audrey B. Davis

Library of Congress

Dorothea Dix

Dixie is the name of a famous song especially popular in the southern United States. Daniel D. Emmett, a member of a minstrel troupe, made the song a hit when he performed it in 1859 in New York City. It was used as a closing number because it involved the entire company. Emmett may have learned "Dixie" from a family of black musicians in his hometown of Mt. Vernon, Ohio.

At the start of the American Civil War (1861-1865), both Union and Confederate troops played and sang versions of "Dixie." Gradually, the song became a battle hymn for Confederate troops. After the Confederate Army surrendered in 1865, President Abraham Lincoln asked a band at the White House to play "Dixie," reclaiming it as a song for the entire nation. But the song remains a symbol of Southern identity. Valerie Woodring Goertzen

Dixie, also called Dixieland, is a name often given to the southern United States. There are different explanations for this name. A Louisiana bank once printed $10 bills bearing the French word *dix,* which means *ten.* According to one story, people called Louisiana "Dix's Land," and then shortened it to Dixie. In time, *Dixie* came to mean the entire South. In another story, a slaveowner named Dixie, or Dixy, was said to be kind to his slaves. "Dixie's Land" became known in many Southern stories as a happy, comfortable place to live. Gradually, the term came to refer to the South. Dan L. Flores

Dixie Highway is a series of scenic automobile roads leading from the Straits of Mackinac, at Lake Michigan's northern tip, to Miami, near the southern end of the Florida peninsula. It has two main routes, an east and a west route. The east route passes through Detroit, Michigan; Cincinnati, Ohio; and Jacksonville, Florida. The west route passes through South Bend, Indiana; Louisville, Kentucky; and Atlanta, Georgia. Carl G. Fisher, a pioneer automobile maker, originated the idea of the Dixie Highway to encourage the building of better roads. Work on the highway began in 1915. Bruce E. Seely

Dixiecrat Party is the nickname for the States' Rights Democratic Party. In the 1948 election, many Southern Democrats objected to their party's civil rights program. They formed the Dixiecrat Party and nominated Strom Thurmond for president and Fielding L. Wright for vice president. The party carried four Southern states (see **Electoral College** [table]). Donald R. McCoy

Dixon, Joseph (1799-1869), was an American inventor and manufacturer. He founded a factory to make lead pencils and stove polish from graphite at Salem, Massachusetts, in 1827. In 1832, he patented a process of using colored inks to prevent counterfeiting. Dixon also patented and introduced graphite crucibles for making pottery and steel. He was born in Marblehead, Massachusetts, on Jan. 18, 1799, and died on June 15, 1869.

Dixon, Sharon Pratt. See Kelly, Sharon Pratt.

Dizziness is a condition in which people feel that their surroundings are whirling about, or that they are falling. This type of dizziness is called *vertigo.* Another type of dizziness is characterized by light-headedness, the sensation that comes before fainting. It causes a person to stagger or fall. Often there is nausea and vomiting. Brief periods during which there is a reduced flow of blood to the brain may cause dizziness. It may also be caused by changes in the pressure of the fluid in the semicircular canals of the inner ear. Dizziness often accompanies such disorders as anemia, epilepsy, heart trouble, and

diseases of the inner ear. See also **Ear** (Disturbances of the organs of balance). Richard D. Penn

Djakarta. See **Jakarta**.

Djibouti, *jih BOO tee,* is a small country in northeastern Africa. It lies on the western shore of the Gulf of Aden. The Gulf of Aden and the Red Sea and Suez Canal to the north link the Indian Ocean and the Mediterranean Sea. Djibouti's location has helped make the country's capital, which is also called Djibouti, a major port. The location also has strategic importance. Ships travel freely past Djibouti's coast. But it would be possible for a powerful nation that gained possession of the area to control the passage of vessels traveling between the Indian Ocean and the Mediterranean Sea.

Djibouti is an extremely poor country with almost no natural resources. In 1977, it gained independence from France, which had ruled the area since the late 1800's. The French originally called Djibouti *French Somaliland,* but in 1967 they renamed it the *French Territory of the Afars and Issas.*

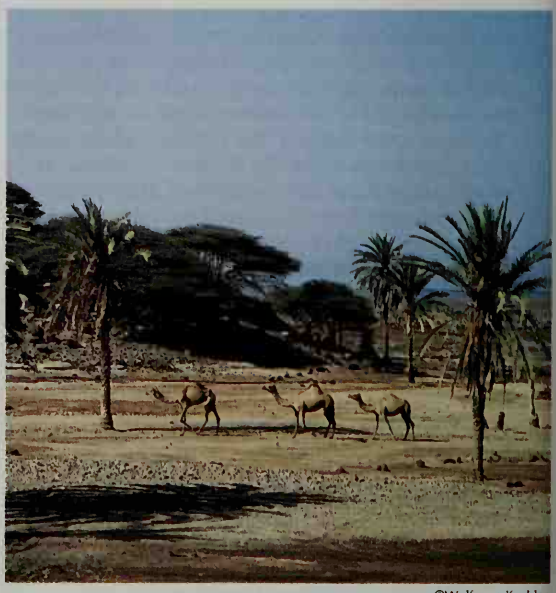
Government. A president heads the government of Djibouti. The people elect the president to a six-year term. The president may not serve more than two terms. The people also elect the 65 members of the nation's legislature, which is called the Chamber of Deputies.

People. Two ethnic groups, the *Afars* and the *Issas,* make up most of Djibouti's population. The Afars live in the north and west. The Issas, a Somali people, live in the south. Djibouti also has small French and Arab populations.

The Afars and the Issas have traditionally been nomads. Today, many of them still wander over the desolate countryside with herds of goats, sheep, camels, and cattle. Scorching heat, a scarcity of water, and a shortage of grazing lands make life difficult for the nomads. As a result, almost 250,000 Afars and Issas now live in the city of Djibouti. But poverty and an unemployment rate as high as 80 percent plague the people who live in the capital. Many people chew *khat* (also spelled *kat* or *qat*). Khat is a leaf that produces a feeling of well-being when it is chewed. Large numbers of workers spend up to 50 percent of their income on khat.

The official language of Djibouti is Arabic, but most of the people speak Afar or Somali. A large majority of the people are Muslims. Educational opportunities are limited in Djibouti, and less than half of the population can read and write.

Land and climate. The terrain of Djibouti is extremely desolate. A barren plain stretches along the country's coast. Farther inland is a mountain range with several peaks that rise more than 5,000 feet (1,500 meters) above sea level. A rugged plateau lies beyond the mountains. Vegetation is scarce throughout the country.



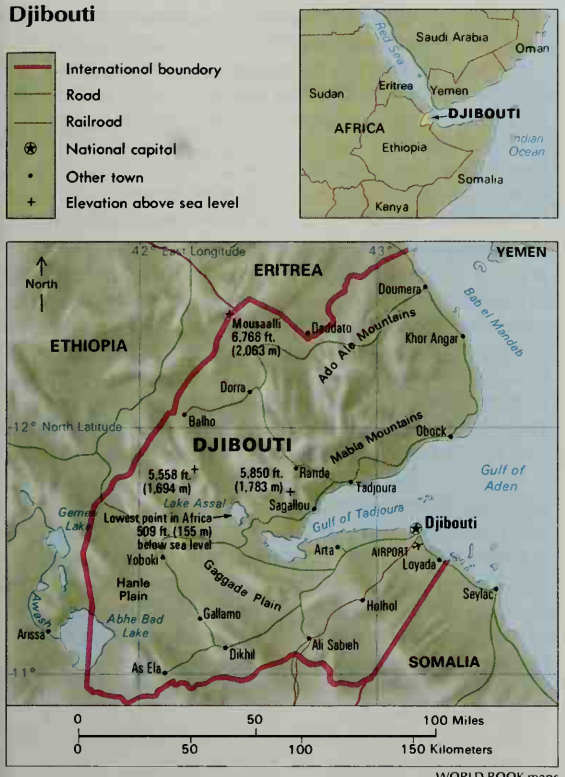
©Wolfgang Kaehler

Djibouti is a country in northeastern Africa. An area with vegetation, *shown here,* is suitable for camel herding. But the country is extremely hot and dry, and vegetation is scarce.

Kay Honkanen

The city of Djibouti is the capital of the country of Djibouti. It is the home of more than half of the nation's people. This photograph shows people walking in a public square next to the city's main *mosque* (Muslim house of worship).

Djibouti



WORLD BOOK maps

Djibouti has one of the hottest and driest climates in the world. The temperature in Djibouti averages 85 °F (29 °C), and it sometimes rises above 107 °F (42 °C) from May to October. The country receives less than 5 inches (13 centimeters) of rain annually.

Economy. Djibouti is extremely poor and underdeveloped. It has no natural resources of any importance and no industry except for two soft-drink plants. Djibouti's only agricultural activity is livestock herding. The nation's economy is based almost entirely on the capital's port and a railroad linking it with Addis Ababa, Ethiopia. Djibouti is a major port for Ethiopian trade. The country has a good harbor and an international airport.

History. People have lived in what is now Djibouti since prehistoric times. During the A.D. 800's, missionaries from Arabia converted the Afars who inhabited the area to Islam. The Afars set up several Islamic states, which fought a series of wars with Christian Ethiopia from the 1200's through the early 1600's. By the 1800's, the Issas had taken over a large part of the Afars' grazing lands, and hostility grew between the two groups.

France bought the Afar port of Obock in 1862 and founded a coaling station for French ships there in 1881. The French signed agreements in 1884 with the Afar sultans of Obock and nearby Tadjoura. In 1888, the French occupied the uninhabited area that would become the city of Djibouti. They then united various small possessions in the area into one territory and named it French Somaliland.

The French developed good relations with Emperor Menelik II of Ethiopia, who decided to have a railway built from his capital, Addis Ababa, to the city of Djibouti. In 1897, he made Djibouti the official port for Ethiopian trade. The city grew rapidly, but little development occurred elsewhere in the territory.

After World War II ended in 1945, the Issas and some other groups in French Somaliland began to demand independence from France. However, the French kept these groups under control. Against the opposition of the Issas, the territory voted in 1958 to join the French Community. This organization is an economic and cultural association that links France and its territories.

In 1967, French Somaliland voted to continue its association with France and was renamed the French Territory of the Afars and Issas. But opposition to French rule grew during the 1970's, when the Issa population increased rapidly. In May 1977, the people voted overwhelmingly for independence. As a result, the territory became the independent nation of Djibouti on June 27, 1977. Hostility between the Afars and the Issas has continued since independence. In 1991, government forces dominated by Issas began to fight rebel Afar guerrillas. In 1994, both sides signed a peace agreement. But some Afar rebels continued fighting against the government. In 2000, the last remaining rebel group and the government signed a peace agreement. Richard Pankhurst

See also **Djibouti** (city).

Facts in brief

Capital: Djibouti (city).
Official language: Arabic.
Area: 8,958 mi² (23,200 km²). *Greatest distances*—east-west, 110 mi (177 km); north-south, 125 mi (201 km). *Coastline* —152 mi (245 km).
Elevation: *Highest*—Mousaalli, 6,768 ft (2,063 m) above sea level. *Lowest*—Lake Assal, 509 ft (155 m) below sea level.
Population: *Estimated 2002 population*—665,000; density, 74 per mi² (29 per km²); distribution, 83 percent urban, 17 percent rural. *1960-1961 census*—81,200.
Chief products: Hides, skins.
Flag: The flag has a blue horizontal stripe at the top, a green horizontal stripe at the bottom, and a red star on a white triangle near the staff. Adopted in 1977. See **Flag** (picture: Flags of Africa).
Money: *Basic unit*—Djibouti franc.

Djibouti, *jih BOO tee* (pop. 317,000), is the capital of Djibouti, a country in northeastern Africa. Over half of the nation's people live in the city of Djibouti. The city lies on the Gulf of Aden and has one of the best ports on Africa's eastern coast (see **Djibouti** [map]). A railroad joins Djibouti with Addis Ababa, Ethiopia's capital; many Ethiopian exports and imports pass through Djibouti's harbor. In 1888, France took control of the Djibouti area, which was then uninhabited. The French founded the city that year. In 1896, they made it the capital of French Somaliland (now the country of Djibouti). They developed the city as a well-planned colonial capital with many fine public and commercial buildings. Djibouti's population has grown rapidly since the mid-1900's, and large slums have developed. Stephen K. Commins

Djugashvili, Iosif. See **Stalin, Joseph.**

DMSO is a controversial drug used to treat such conditions as arthritis, bursitis, and sprains. When applied externally, the drug is quickly absorbed through the skin into the bloodstream. Supporters of DMSO claim that it is remarkably effective in relieving pain and reducing inflammation. But the United States Food and Drug Ad-

ministration (FDA) has not approved the drug for external use on human beings. It can be used internally to treat a bladder condition called *interstitial cystitis.*

DMSO stands for *dimethyl sulfoxide,* a compound obtained as a by-product of paper manufacturing. DMSO has long been used as an industrial solvent, but scientists did not discover its medicinal properties until the early 1960's. Thousands of people used DMSO until 1965, when the FDA banned it as a human drug. The FDA based its decision on reports that the drug caused eye damage in experiments with animals. Although eye damage has not been observed in people treated with DMSO, it has caused minor side effects such as bad breath, headaches, nausea, and skin rashes.

The FDA later allowed limited testing of DMSO. The drug was approved for cystitis in 1978. But many Americans obtain and use it for a variety of other ailments. Some people treat themselves with industrial DMSO, though it may contain harmful impurities.

Eugene M. Johnson, Jr.

DNA, also known as *deoxyribonucleic acid*, is a thin, chainlike molecule found in every living cell on earth. It directs the formation, growth, and reproduction of cells and organisms. Short sections of DNA called *genes* determine *heredity*—that is, the passing on of characteristics—in living things. DNA is found mainly within a cell's nucleus, in threadlike structures called *chromosomes.* DNA even occurs in bacterial cells, which do not have a nucleus, and in some viruses.

All DNA consists of thousands of smaller chemical units called *nucleotides.* Nucleotides are chemically bonded to one another to form thin, chainlike molecules known as *polynucleotides.* Each nucleotide contains a compound called a *phosphate,* a sugar called *deoxyribose,* and a compound called a *base.* The phosphate and sugar are the same in all DNA nucleotides, but the bases vary. There are four DNA bases: (1) *adenine,* (2) *guanine,* (3) *thymine,* and (4) *cytosine.* The exact amount of each nucleotide and the order in which they are arranged are unique for every kind of living thing.

The DNA molecule consists of two polynucleotide chains arranged in a double *helix* (spiral). This double helix resembles a twisted rope ladder. Polynucleotide chains of phosphates and sugars form the sides of the ladder. Each rung represents two matching bases, called *base pairs.* Weak chemical bonds between specific base pairs hold the chains together.

DNA bases are paired in a specific way. For example, an adenine base on one polynucleotide chain always bonds with a thymine base on the opposing chain. Similarly, guanine on one chain always bonds with cytosine on the other. Because the sequence of bases in one chain is determined by the sequence of bases in the other, scientists say the two chains are *complementary.*

Before a cell divides, it duplicates its DNA. The two chains of polynucleotides separate lengthwise, splitting the bonds between the base pairs. The separated chains, each resembling half a ladder split down the middle, serve as *templates* (patterns) for two new DNA molecules. A cell's nucleus contains additional nucleotides. The bases of these nucleotides bond with their corresponding bases on one of the templates. This process is repeated thousands of times to form two new DNA molecules identical to the original. Thus, when the cell divides, each of the resulting daughter cells receives identical DNA molecules. Irwin Rubenstein

Related articles. For a detailed discussion, see **Cell** and **Heredity**. See also the following articles:

Crick, Francis H. C.
DNA fingerprinting
Franklin, Rosalind E.
Gene mapping
Human Genome Project
Life (Diagram: The importance of carbon in life)
RNA
Watson, James D.
Wilkins, Maurice H. F.

DNA fingerprinting, also called *DNA typing* or *DNA analysis,* is a technique used to help identify individuals in criminal and other cases through the analysis of genetic material. This material, known as *deoxyribonucleic acid* (DNA), is found in body cells. In DNA fingerprinting, investigators obtain and analyze DNA from the cells of individuals involved in criminal or civil investigations. The cells may come from almost any body fluid or tissue, including bone, blood, semen, hair, or teeth.

In criminal cases, the use of DNA fingerprinting is based on the fact that it is extremely unlikely that any two unrelated individuals possess identical DNA. Investigators may compare DNA found at the crime scene with DNA from a suspected criminal. On the basis of this comparison, the suspect may be included or excluded as a possible source of the DNA found at the scene of the crime. Law enforcement agencies have used DNA fingerprinting to create databases of genetic profiles of convicted criminals.

DNA fingerprinting is also used to settle *paternity disputes*—that is, to determine the biological father of a child. In paternity cases, the use of DNA fingerprinting is based on the fact that a child's DNA has some of the same characteristics as the DNA of the father.

In the United States, DNA fingerprinting was first used as evidence in 1986 in Pennsylvania. Since then, it has become widely accepted by courts in both criminal and paternity cases. However, attorneys sometimes attack certain kinds of DNA evidence because it may become contaminated. Lawrence A. Presley

See also **DNA**.

Dnepr River, *DNYEH puhr,* also spelled *Dnipro* and *Dnyapro,* is one of the longest rivers in Europe. It flows through an important economic region. The Dnepr rises in the Valdai Hills, near the city of Smolensk in Russia. It flows south for 1,420 miles (2,285 kilometers) through Russia, Belarus, and Ukraine. It empties into the Black Sea. Kiev, Ukraine's capital, lies on the river. The northern part of the Dnepr flows through a forested area, and the southern part through farmland and an industrialized region. The Dnepr drains an area of about 195,000 square miles (504,000 square kilometers). For the location of the Dnepr River, see **Europe** (terrain map).

The construction of dams and reservoirs has deepened the Dnepr and removed obstacles caused by rapids. As a result, the river is navigable for its entire course. One of the largest dams is the Dneproges Dam. The Dnepr is an important route for the transportation of cargo, including coal and grain from Ukraine and timber from the north. Important tributaries include the Berezina, Desna, Ingulets, Pripyat, and Psel (also spelled *Psol*) rivers. Canals connect the Dnepr with several rivers that empty into the Baltic Sea, which lies to the northwest. Leszek A. Kosinski

See also **Ukraine** (picture).

Dnepropetrovsk, *NEHP roh pih TRAWFSK* (pop. 1,187,000), is a major industrial city in Ukraine. It lies in east-central Ukraine, on the Dnepr River. For the location of Dnepropetrovsk, see **Ukraine** (political map).

Dnepropetrovsk is situated near the Donbas coal fields, the Krivoy Rog iron mines, and the Nikopol manganese mines. These rich mineral resources supply raw materials for the city's huge iron and steel industry. Building materials, chemicals, food products, and heavy machinery are also produced in the city. Dnepropetrovsk has an airport and a large harbor.

Dnepropetrovsk is the home of a state university and a number of specialized technical schools. Shevchenko Park, named for the Ukrainian patriot and poet Taras Shevchenko, is a popular recreation area.

Dnepropetrovsk was founded by Prince Gregory Potemkin of Russia in 1776. At that time, the city was called Ekaterinoslav. It took its present name in 1926.

Jaroslaw Bilocerkowycz

Doberman pinscher, *DOH buhr muhn PIHN shuhr,* is a breed of dog that originated in Germany. It is named after Louis Dobermann, a German dog breeder. Dobermann first developed the dogs in the late 1800's. Dobermans are strong and muscular, and they have great

WORLD BOOK photo by Ken Love

The Doberman pinscher is an intelligent watchdog.

speed and endurance. They are alert and fearless and make good guard dogs and police dogs. With proper training, Dobermans also make affectionate, loyal pets. A Doberman's short, smooth coat can be black, blue, red, or fawn (tan), with rust-colored markings. Most Dobermans have *docked* (cut short) tails and *cropped* (clipped) ears. Male Dobermans stand 26 to 28 inches (66 to 71 centimeters) tall at the shoulder. Females are 24 to 26 inches (61 to 66 centimeters) tall.

Critically reviewed by the Doberman Pinscher Club of America

Dobie, J. Frank (1888-1964), an American author and professor, became famous for his writings on the Southwest. In 20 books and hundreds of articles, Dobie collected or retold stories about cowboys, longhorn cattle, and other people and animals of the range country.

James Frank Dobie was born on a ranch in Live Oak County, Texas. For most of the period from 1913 to 1947, he was an English professor at the University of Texas. For many years, Dobie served as secretary and editor of the Texas Folklore Society. Dobie's first book was *A Vaquero of the Brush Country* (1929), which describes the experiences of a Texas cattleman during pioneer days. Dobie's other works include *Coronado's Children* (1930), *The Longhorns* (1941), *The Mustangs* (1952), and *Tales of Old-Time Texas* (1955).

Arthur R. Huseboe

Dobsonfly. See **Hellgrammite.**

Dock is the name of several species of plants found in many regions worldwide. Two common species—the *curly dock,* also called *yellow dock* because of the color of the root; and the *broadleaf dock*—grow as weeds in the United States and Canada. These plants infest gardens and lawns and are common along waysides. They grow from 2 to 4 feet (61 to 122 centimeters) high and have long, large leaves with wavy edges. Their small, greenish or reddish flowers are often dried for flower arrangements. Their large roots are used medicinally for tonics, astringents, and skin remedies. Docks may be controlled by pulling out the root or by spraying with a *herbicide* (chemical weedkiller).

Harold D. Coble

Scientific classification. Dock plants belong to the buckwheat family, Polygonaceae. The scientific name for the curly dock is *Rumex crispus.* The broadleaf dock is *R. obtusifolius.*

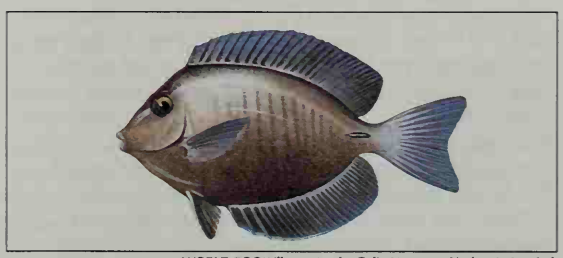
Doctor. See **Degree, College** (The doctor's degree); **Medicine** (Providing medical care; Careers in medicine).

Doctorfish is a tropical fish found in the Atlantic Ocean. It is grayish-brown to dark brown and has 10 to 12 vertical markings on its sides. Its fins are blue to gray. The doctorfish belongs to a group of fish called *surgeonfish.* Like other surgeonfish, it has a sharp, scalpel-shaped spine that folds into a groove on each side of the body near the tail. The spine can be raised out of the groove and used to slash at attacking fish.

The fish use their small, sharp teeth to scrape algae from hard-packed sand and rocks. The algae are ground up in the fish's muscular stomach. Doctorfish graze in schools, often with other surgeonfish.

Tomio Iwamoto

Scientific classification. The doctorfish is a member of the surgeonfish family, Acanthuridae. It is *Acanthurus chirurgus.*



WORLD BOOK illustration by Colin Newman, Linden Artists, Ltd.

The doctorfish has a brownish body and blue to gray fins.

Doctors Without Borders, also known by its French name *Médecins sans Frontières* (MSF), is an international relief organization dedicated to providing medical aid to populations who are in danger. The group sends medical personnel, medical supplies, food, fresh water, and other necessities to regions where people are at risk from war, disease, civil strife, or natural disasters. For this humanitarian work, the organization was awarded the 1999 Nobel Peace Prize.

The organization was founded in 1971 by a group of

doctors frustrated with the complications of international medical relief efforts. Doctors Without Borders is a private, nonprofit organization that arranges relief in more than 80 countries each year. Thousands of medical professionals volunteer their time and skills. They provide primary health care, perform surgery, and repair and improve public health facilities all over the world.

The name Doctors Without Borders refers to the group's philosophy of providing aid to people who are in danger, regardless of politics or national boundaries. The organization does speak out, however, if volunteers in the field become aware of widespread human rights violations or atrocities taking place against civilians.

Critically reviewed by Doctors Without Borders

Doctorow, E. L. (1931-), is an American novelist. His works are noted for their mingling of American history and literary imagination through the interaction of fictional and real-life characters.

Doctorow's first novel, *Welcome to Hard Times* (1960), is set in the late 1800's. It attacks the optimistic belief in the promise of a better life on the Western frontier. *The Book of Daniel* (1971) describes a man's attempt to discover the truth about his parents, who had been executed as Communist spies. *Ragtime* (1975), set in the early 1900's, contrasts economic progress and patriotism with social unrest and inequalities in American life. *Lives of the Poets* (1984) examines the artist's place in society.

Three of Doctorow's novels are set in the 1930's. *Loon Lake* (1980) tells a "rags to riches" story of a man who is shown to be corrupt. *World's Fair* (1985) is an autobiographical novel about growing up in the Bronx borough of New York City. *Billy Bathgate* (1989) describes a boy's adventures in the gang of a New York City mobster. *The Waterworks* (1994) is a complex mystery story set in New York City in 1871. *City of God* (2000) takes the form of a notebook kept by a New York City novelist. *Jack London, Hemingway, and the Constitution: Selected Essays, 1977-1992* was published in 1993. Edgar Lawrence Doctorow was born in New York City. Arthur M. Saltzman

Dodd, William Edward (1869-1940), a noted American historian, served as United States ambassador to Germany from 1933 to 1937. As ambassador, he protested Adolf Hitler's policies, but the U.S. State Department recalled him from Germany. Dodd wrote the widely read *Ambassador Dodd's Diary* (1941) and made lecture tours in the United States criticizing Nazi Germany. His historical works include *Jefferson Davis* (1907), *Statesmen of the Old South* (1911), *Expansion and Conflict* (1915), and *Woodrow Wilson and His Work* (1920).

Dodd was born in Clayton, North Carolina. He received his Ph.D. degree from the University of Leipzig, Germany. He taught history at Randolph-Macon College and at the University of Chicago. Joseph Martin Hernon, Jr.

Dodder is a type of destructive weed found throughout most of the world. Dodder plants are parasites that take their food from other plants. A dodder grows from seed in the spring. Soon, however, it attaches itself to a nearby plant by means of specialized roots called *suckers* or *haustoria*. The root and older part of the stem then die and break off. Dodder plants destroy a great deal of alfalfa, clover, and flax.

The stems of dodder plants look like yellow, orange, white, and brown threads. The stems twine around other plants and sprawl from one plant to another, forming tangled masses. A dodder's small, whitish or yellowish flowers often form in dense clusters. Daniel F. Austin

Scientific classification. Dodder plants are in the morning-glory family, Convolvulaceae. They make up the genus *Cuscuta*.

See also **Plant** (picture: How nongreen plants get their food).

Dodge, Mary Elizabeth Mapes (1831-1905), an American author, wrote *Hans Brinker, or, The Silver Skates* (1865), a famous children's book about the Netherlands. Within 30 years, the book had appeared in more than 100 editions and was translated into six languages. Dodge was recognized as a leader in the field of juvenile literature. She became editor of the magazine *St. Nicholas* when it began in 1873, and she got the best authors of the time to contribute to the publication.

Dodge was born in New York City and grew up in a home that was a center for literary groups. William Cullen Bryant and Horace Greeley were frequent visitors. Her husband died when she was 27, leaving her with two small sons. Because she had to support them, she returned to her father's home in Newark, New Jersey, and started her literary career. Jill P. May

Dodge brothers were two pioneers in automobile manufacturing. Both John Francis Dodge (1864-1920) and Horace Elgin Dodge (1868-1920) were born in Niles, Michigan. The Dodge brothers began their business careers making bicycles. In 1901, they opened a machine shop in Detroit. The brothers built parts for the Olds Motor Works and Ford Motor Company. They began making their own automobiles in 1914 and produced one of the first American automobiles with an all-steel body. Horace Dodge invented many improvements for automobiles, including an oven for baking enamel on steel bodies. The Dodge Company became part of Chrysler Corporation in 1928. William L. Bailey

Dodge City, Kansas (pop. 25,176), was a well-known "Wild West" frontier town. It was called the *Cowboy Capital of the World* and, at times, the *Wickedest Little City in the West* and *Queen of Cowtowns*. Dodge City lies on the Arkansas River, in southwestern Kansas (see **Kansas** [political map]). Dodge City is the chief commercial center of the region. It is also an agricultural center and a leading beef-slaughtering and meat-packing center. Dodge City is the seat of Ford County and has a commission government with a city manager.

Traders on the Santa Fe Trail traveled through the area in the 1800's. Dodge City was established when the Atchison, Topeka, and Santa Fe (now the Burlington Northern and Santa Fe) Railway came in 1872. Until that year, the town was called Buffalo City. From 1875 to about 1885, Dodge City was a major regional shipping point for cattle. Many gunmen lived in the city, and such famous peace officers as Wyatt Earp and Bat Masterson enforced the law. A restoration of Boot Hill and Front Street, the city's old main street, make up a popular tourist attraction. The name *Boot Hill* came from an early cemetery where cowboys and gunmen were buried still wearing their boots. Brian Reetz

See also **Kansas** (picture: Restoration of Front Street).

Dodgson, Charles Lutwidge. See **Carroll, Lewis**.

Dodo, *DOH doh,* is an extinct, flightless bird related to the pigeon. The dodo was about the size of a large turkey. It had short legs, an enormous beak, stubby wings, and a tuftlike tail with curly feathers. The dodo lived on

Oil painting on canvas; Thomas Gilcrease Institute of American History and Art, Tulsa, Okla.

Dodge City was the scene of many gunfights during the late 1800's. Western artist Charles Marion Russell portrayed one vividly in his painting *When Guns Speak, Death Settles Disputes.*

the island of Mauritius in the Indian Ocean. It laid a single egg on the ground. Two related species called *solitaires* lived on nearby Reunion and Rodrigues islands.

European sailors killed the birds for food. Pigs and monkeys brought to the island by Portuguese sailors during the 1500's destroyed the eggs and ate the young. The dodo died out about 1680, the Reunion solitaire about 1750, and the Rodrigues solitaire about 1800. Several dodos, and possibly some solitaires, were exhibited alive in Europe and served as models for paintings. The heads and feet of a few dodos are preserved in museums, but the solitaires are known only from pictures, from accounts written by travelers, and from bones that were found on Reunion and Rodrigues islands.

WORLD BOOK illustration by Trevor Boyer, Linden Artists Ltd.

The dodo had tiny wings that were so small it could not fly. Dodos lived on the island of Mauritius in the Indian Ocean. They have been extinct since about 1680.

Scientific classification. The dodo and solitaires are in the dodo and solitaire family, Raphidae. The dodo is *Raphus cucullatus.* The Reunion solitaire is *Raphus solitarius,* and the Rodrigues solitaire is *Pezophaps solitaria.* Alan Feduccia

Dodoma, *DOHD uh MAH* (pop. 45,703), is a city in central Tanzania. In 1973, Tanzanians voted to move the country's capital from the coastal city of Dar es Salaam to Dodoma. The move was scheduled for completion by 2005. Dodoma was selected as the new site of the capital primarily because of its central location. For location, see **Tanzania** (map).

Dodoma's business district includes a number of modern commercial buildings. Most of the people live in small brick houses with tin roofs. Dodoma's industries include the manufacturing of bricks, and clay processing. A railroad links Dodoma with Tanzania's east and west coasts, and an airport lies near the city.

Dodoma was a small village when the mainland of what is now Tanzania became a German colony in 1891. In the early 1900's, Britain gained control of the colony, and Dodoma became a marketing center. Dodoma's population has more than doubled since the colony gained independence in 1961. Stephen K. Commins

Doe. See **Deer; Goat.**

Doenitz, *DAY nihts,* **Karl** (1891-1980), a German admiral, became commander in chief of the German fleet in January 1943, during World War II. Before this appointment, he directed development of the German submarine service. He invented the "wolf pack" technique of submarine warfare to penetrate convoy defenses. With the collapse of Germany in 1945, Adolf Hitler chose Doenitz to succeed him as head of state. Doenitz concluded peace with the Allies.

Doenitz was a loyal Nazi and an admirer of Hitler. He was tried for war crimes and crimes against peace in Nuremberg, Germany and was sentenced to 10 years in prison. He was released in 1956. Doenitz was born in Grünau, near Berlin. Donald M. McKale

Some breeds of dogs have unusual characteristics. A Chinese shar-pei puppy, *left,* has a wrinkled coat that looks too large for its body. A black tongue is the distinguishing feature of the chow chow, *center.* The puli, *right,* has a coat that becomes tangled into long, ropelike cords.

WORLD BOOK photo by Brent Jones

WORLD BOOK photo

WORLD BOOK photo by Dave G. Wacker

Dogs provide companionship for people of all ages. These children's affectionate friend is a *mongrel* (mixed-breed dog). In general, mongrels display the dominant traits of each of their parents and make excellent pets.

WORLD BOOK photo

Specially trained dogs perform many tasks. This German shepherd uses its keen sense of smell to detect drugs being smuggled into the United States.

WORLD BOOK photo

Dog

Dog is an animal that has lived with people as a pet for more than 10,000 years, longer than any other animal. During that time, breeders have developed about 400 dog breeds to perform various tasks, provide companionship, and please the human eye.

Most scientists believe that prehistoric human beings first valued dogs as watchdogs. Later, people realized that dogs could also be used for herding and hunting other animals. Over thousands of years, such breeds as collies, komondors, and pulis were developed to herd sheep, goats, and cattle. Hounds, pointers, retrievers, setters, spaniels, and terriers were bred for various kinds of hunting.

The intelligence, loyalty, and tracking ability that make dogs useful to herders and hunters serve people in other roles as well. For example, the police use dogs to track criminals and to sniff out illegal drugs and hidden explosives.

Dogs of all breeds provide company for human beings, and many breeds were developed for this purpose. These breeds include most of the small breeds called *toy dogs,* such as Japanese chins and Pomeranians. The companionship of a dog can contribute to a person's general well-being. Scientific studies have shown that petting a dog slows the heart rate and lowers the blood pressure of the person who is doing the petting.

Dogs assist disabled people in many ways. For example, they guide the blind and serve as "ears" for the deaf. In addition, dogs lift the spirits of patients in hospitals and nursing homes.

Dogs have also entertained people for centuries. In earlier times, audiences enjoyed betting on fights between dogs and between dogs and other animals, such as bears, bulls, and lions. Many countries now ban such fights. Today, such contests as dog racing, field trials, and obedience trials draw large crowds. Dogs also perform in circuses, on stage, in motion pictures, and on television.

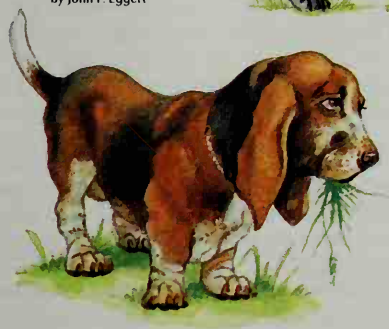
Some dog breeds have an unusual appearance. For example, the Mexican hairless has no fur on its body except for a few tufts on the top of the head. The loose skin of the Chinese shar-pei folds into wrinkles. These wrinkles are so deep that they may cover the animal's eyes. The chow chow has a blue-black tongue. The

Terri McGinnis, the contributor of this article, is a veterinarian and the author of The Well Dog Book.

Why dogs do the things they do

Tail chasing is a normal form of play for puppies. A puppy instinctively chases the tip of the tail, possibly because it resembles moving prey. Adult dogs are more likely to chase their tails because of inadequate exercise or inadequate attention from their owners. They also may have fleas or some other medical problem.

WORLD BOOK illustrations by John F. Eggert



Eating grass. Most dogs seem to enjoy the flavor of grass. Dogs also eat grass when they have digestive disorders. The grass causes vomiting, which can help make the dog feel better.

Digging is an instinctive activity that dogs retain from their wild ancestors. The ancestors of dogs often buried part of the food they caught on hunts to protect it from other animals. Dogs frequently bury bones or food, or simply dig holes.

Panting helps a dog stay cool. When saliva evaporates from the tongue and mouth, it has a cooling effect that helps reduce the dog's body heat. Unlike people, dogs cannot cool themselves by perspiring. They have sweat glands only in their feet, and the glands have little effect on body temperature.

basenji is the only dog that cannot bark, though it can make a singing sound.

The body of a dog

Dogs vary greatly in size. The smallest breed of dog is the chihuahua. Most chihuahuas stand about 5 inches (13 centimeters) tall at the shoulder. Most chihuahuas weigh no more than 6 pounds (2.7 kilograms). The heaviest dogs are mastiffs and St. Bernards. Large male mastiffs and St. Bernards may weigh 200 pounds (90 kilograms). The tallest dogs are the Irish wolfhound and the Great Dane, both of which can reach heights of 39 inches (99 centimeters) tall at the shoulder.

The shape and other characteristics of a dog's body also vary widely from breed to breed. Dog breeds look so different from one another that it may be hard to believe that they are closely related. Nevertheless, dogs all have the same basic physical features. Except for limitations in size, all breeds can mate with one another and produce offspring.

Body structure is primarily determined by the dog's skeleton, which has an average of 320 bones. The exact number of bones varies, depending on the length of the dog's tail. A male dog has one more bone than a female of the same breed because he has a bone called the *os penis* in his penis.

Some breeds, such as the Boston terrier and the bulldog, are born with short tails. Other breeds, including poodles, cocker spaniels, schnauzers, and boxers, are born with long tails, but a veterinarian may *dock* (cut off) the tail a few days after birth. This surgery does not benefit the dog and is only done because some people prefer the appearance of a docked tail.

Most dogs have long legs. But some breeds, such as dachshunds, carry a gene for dwarfism that makes the leg bones extremely short and thick.

The shape of the skull determines whether a dog has a long, slender face like that of a collie or a short, broad face like that of the bulldog, pug, and Pekingese. Long-faced dogs have eyes that are nearer the sides of their heads, giving them a wide field of vision. Dogs with broad skulls have eyes that look forward like those of

Dog terms

Bitch is an adult female dog.
Breed standard is an official description of a breed.
Canine is another word for *dog* or *doglike*. The term comes from *canis,* the Latin word for *dog*.
Dog is an adult male dog. However, the term is generally used for all dogs, regardless of age or sex.
Litter is a group of puppies born at one time to one female.
Mixed-breed means a dog whose parents belong to different breeds or have mixed ancestry themselves.
Pedigree is a record of a purebred dog's ancestors.
Puppy is a dog less than 1 year old.
Purebred means a dog whose parents belong to the same breed.
Studbook is a book in which breeders register the pedigrees of dogs.
Whelp is an unweaned puppy—that is, one that still feeds on its mother's milk. The term also means to give birth to puppies.

Breeds of purebred dogs recognized by the AKC

Breed*	Place and probable date of origin	Average weight In lbs	In kg
Sporting group			
American water spaniel	United States, 1800's	25-45	11-20
Brittany	France, 1800's	35-40	16-18
Chesapeake Bay retriever	United States, 1800's	65-80	29-36
Clumber spaniel	England, 1800's	55-85	25-39
Cocker spaniel	England, 1800's	22-28	10-13
Curly-coated retriever	England, 1800's	50-80	23-36
English cocker spaniel	England, 1800's	26-34	12-15
English setter	England, 1500's	50-70	23-32
English springer spaniel	England, 1800's	37-55	17-25
Field spaniel	England, 1800's	35-50	16-23
Flat-coated retriever	England, 1800's	60-75	27-34
German shorthaired pointer	Germany, about 1900	45-70	20-32
German wirehaired pointer	Germany, 1870	55-65	25-29
Golden retriever	Scotland, 1870	55-75	25-34
Gordon setter	Scotland, 1600's	45-80	20-36
Irish setter	Ireland, 1700's	60-70	27-32
Irish water spaniel	Ireland, 1800's	45-65	20-29
Labrador retriever	Newfoundland, 1800's	55-75	25-34
Pointer	Europe, about 1650	45-75	20-34
Spinone Italiano	Italy, ancient times	61-85	28-39
Sussex spaniel	England, 1800's	35-45	16-20
Vizsla	Hungary, 1000's	50	23
Weimaraner	Germany, 1800's	60-80	27-36
Welsh springer spaniel	Wales, 1700's	40	18
Wirehaired pointing griffon	Netherlands and France, 1800's	50-60	23-27
Hound group			
Afghan hound	Unknown	50-60	23-27
American foxhound	United States, 1600's	60-70	27-32
Basenji	Africa, 3400 B.C.	22-24	10-11
Basset hound	France, 1600's	45-60	20-27
Beagle	England, Wales, 1600's	18-30	8-14
Black and tan coonhound	United States, 1700's	50-60	23-27
Bloodhound	Middle East, 100 B.C.	80-110	36-50
Borzoi	Russia, 1600's	60-105	27-48
Dachshund	Germany, 1700's	5-20	2.3-9
English foxhound	England, 1600's	60-75	27-34
Greyhound	Egypt, 4000-3500 B.C.	60-70	27-32
Harrier	France, 1000's	40-50	18-23
Ibizan hound	Egypt, ancient times	42-50	19-23
Irish wolfhound	Ireland, 400's	126-145	57-66
Norwegian elkhound	Norway, 5000-4000 B.C.	50	23
Otter hound	England, 1300's	65-115	29-52
Petit basset griffon vendéen	France, 1600's	30-42	14-19
Pharaoh hound	Egypt, about 4000 B.C.	50	23
Rhodesian ridgeback	Africa, 1700's	65-75	29-34
Saluki	Middle East, about 7000 B.C.	60	27
Scottish deerhound	Scotland, 1500's	75-110	34-50
Whippet	England, 1800's	18-23	8-10
Working group			
Akita	Japan, 1600's	80-120	36-54
Alaskan malamute	Alaska, 1000 B.C.	75-85	34-39
Anatolian shepherd	Turkey, ancient times	80-150	36-68
Bernese mountain dog	Switzerland, 100 B.C.	50-75	23-34
Boxer	Germany, 1800's	60-75	27-34
Bullmastiff	England, 1800's	100-130	45-59
Doberman pinscher	Germany, 1800's	60-75	27-34
Giant schnauzer	Bavaria, 1600-1800	75	34
Great Dane	Germany, 1500's	120-150	54-68
Great Pyrenees	France, 1800-1000 B.C.	90-125	41-57
Greater Swiss mountain dog	Switzerland, 50 B.C.	90-140	41-64
Komondor	Hungary, 900's	100-150	45-68
Kuvasz	Tibet, 1200's	70-115	32-52
Mastiff	Middle East, ancient times	165-185	75-84
Newfoundland	Newfoundland, date unknown	110-150	50-68
Portuguese water dog	Portugal, 700's	35-60	16-27
Rottweiler	Germany, about A.D. 50	80-90	36-41
St. Bernard	Switzerland, 1600's	140-200	64-90
Samoyed	Northern Siberia, 1000 B.C. or earlier	35-60	16-27
Siberian husky	Siberia, about 1000 B.C.	35-60	16-27
Standard schnauzer	Germany, 1400's	35-40	16-18
Terrier group			
Airedale terrier	England, 1800's	50-60	23-27
American Staffordshire terrier	United States, early 1900's	45-65	20-29
Australian terrier	Australia, 1885	12-14	5.4-6.4
Bedlington terrier	England, 1800's	17-23	8-10
Border terrier	Scottish-English border, 1700's	$11\frac{1}{2}$-$15\frac{1}{2}$	5-7
Bull terrier	England, 1800's	40-60	18-27
Cairn terrier	Scotland, 1700's	13-14	6-6.4
Dandie Dinmont terrier	England, Scotland, about 1700	18-24	8-11
Irish terrier	Ireland, 1700's	25-27	11-12
Jack Russell terrier	England, 1800's	13-17	6-8
Kerry blue terrier	Ireland, 1800's	30-40	14-18
Lakeland terrier	England, 1800's	15-17	7-8
Manchester terrier†	England, 1800's	5-22	2.3-10
Miniature bull terrier	England, 1800's	20-30	9-14
Miniature schnauzer	Germany, 1800's	15	7
Norfolk terrier	England, 1880	10-12	4.5-5.4
Norwich terrier	England, 1880	10-12	4.5-5.4
Scottish terrier	Scotland, 1800's	18-22	8-10
Sealyham terrier	Wales, 1800's	23-25	10-11
Skye terrier	Scotland, 1600's	25	11
Smooth fox terrier	England, mid-1600's	18	8
Soft-coated wheaten terrier	Ireland, 1900's	35-45	16-20
Staffordshire bull terrier	England, 1800's	35	16
Welsh terrier	Wales, 1700's	20	9
West Highland white terrier	Scotland, 1600's	13-19	6-9
Wire fox terrier	England, late 1800's	15-19	7-9
Toy group			
Affenpinscher	Europe, 1700's	7-8	3.2-3.6
Brussels griffon	Belgium, 1600's	8-10	3.6-4.5
Cavalier King Charles spaniel	England and Scotland, 1700's	13-18	6-8
Chihuahua	Mexico, 1500's or earlier	1-6	0.5-2.7
Chinese crested	Africa, 1000-1200	5-10	2.3-4.5
English toy spaniel	Japan or China, ancient times	9-12	4-5.4
Havanese	Mediterranean, 1400's or earlier	12	5.4
Italian greyhound	Italy, 100 B.C.	6-10	2.7-4.5
Japanese chin	China, ancient times	5-9	2.3-4
Maltese	Malta, 800 B.C. or earlier	4-6	1.8-2.7
Miniature pinscher	Germany, 1700's	6-10	2.7-4.5
Papillon	Spain, 1500's	3-9	1.4-4
Pekingese	China, 700's	6-10	2.7-4.5
Pomeranian	Pomerania, Poland, 1800's	3-7	1.4-3.2
Pug	China, 1700's	14-18	6.4-8
Shih Tzu	China, ancient times	9-16	4-7
Silky terrier	Australia, about 1900	8-10	3.6-4.5
Yorkshire terrier	England, 1800's	4-7	1.8-3.2
Nonsporting group			
American Eskimo dog	United States, early 1900's	10-30	4.5-14
Bichon frise	Mediterranean, 200 B.C.	12-15	5.4-7
Boston terrier	Boston, 1870	12-25	5.4-11
Bulldog	England, 1200's	40-50	18-23
Chinese shar-pei	China, about 200 B.C.	40-55	18-25
Chow chow	China, 150 B.C.	50-60	23-27
Dalmatian	Dalmatia, Austria, 1700's	40-50	18-23
Finnish spitz	Finland, about 1500 B.C.	30	14
French bulldog	France, 1400's	18-28	8-13
Keeshond	Holland, 1500's	35-40	16-18
Lhasa apso	Tibet, about 1100	15	7
Löwchen	Europe, Middle Ages	4-9	1.8-4
Poodle**	Germany, 1500's	3-60	1.4-27
Schipperke	Belgium, 1600's	15	7
Shiba inu	Japan, ancient times	20-30	9-14
Tibetan spaniel	Tibet, 200 B.C.	10-12	4.5-5.4
Tibetan terrier	Tibet, about 50 B.C.	22-23	10
Herding group			
Australian cattle dog	Australia, 1800's	35-55	16-25
Australian shepherd	United States, 1800's	35-70	16-32
Bearded collie	Scotland, early 1500's	50-60	23-27
Belgian Malinois	Belgium, 1800's	50-55	23-25
Belgian sheepdog	Belgium, 1800's	55-60	25-27
Belgian Tervuren	Belgium, about 1880	55	25
Border collie	England and Scotland, 1700's	30-50	14-23
Bouvier des Flandres	Flanders, 1800's	70	32
Briard	France, 800's	60-90	27-41
Canaan dog	Israel, ancient times	35-55	16-25
Cardigan Welsh corgi	Wales, about 1200 B.C.	26-34	12-15
Collie	Scotland, 1600's	50-75	23-34
German shepherd dog	Germany, 1800's	60-85	27-39
Old English sheepdog	England, 1800's	50-65	23-29
Pembroke Welsh corgi	Wales, 1107	18-30	8-14
Polish lowland sheepdog	Poland, Middle Ages	35-50	16-23
Puli	Hungary, 1000's	30-35	14-16
Shetland sheepdog	Shetland Islands, 1600's	16-24	7-11

*Each breed listed in this table has a separate article in *World Book*.
†Manchester terriers weighing 12 pounds (5 kilograms) or less are entered in dog shows in the Toy group.
**Poodles measuring 10 inches (21 centimeters) or less are entered in dog shows in the Toy group.
Source: American Kennel Club (AKC).

human beings, giving the dog better ability to judge distances.

Dogs have four toes on each hind foot and five toes on each forepaw. Some dogs are born with an extra toe called the *dewclaw* on each hind foot. Dewclaws serve no purpose and may be torn as a dog runs through brush. For these reasons, veterinarians often remove them along with the first toe on each forepaw when a puppy is a few days old. Dogs have curved toenails, sometimes called claws. Unlike cats, they cannot retract their claws.

Most puppies have 28 temporary teeth, which they begin to lose at about 12 weeks of age. Most adult dogs have 42 permanent teeth, which usually appear by 6 months of age. The dog uses its 12 small front teeth, called *incisors,* to pick up small objects and to groom itself. The 4 long, pointed *canine* or *cuspid teeth* are used to grab and hold large pieces of food. The 16 *premolars* are used to slice off smaller pieces of food. They also provide crushing and grinding action along with the 10 *molars* in the back of the mouth.

Many breeds of dogs have ears that are pointed and stand straight up. Such breeds include German shepherds, chihuahuas, and basenjis. Other breeds, such as the cocker spaniel, Labrador retriever, poodle, and beagle, have long, hanging ears that are called *pendulous ears.* Some people ask their veterinarian to *crop* (cut) the ears of certain long-eared breeds, including boxers and Doberman pinschers, to make them stand up. Cropping is done when the dog is a puppy. Because ear cropping is done only to change the dog's appearance, many veterinarians refuse to perform the surgery. Kennel clubs in numerous countries ban the practice of cropping.

Coat. Dogs have three basic types of hair in their coat. These types are (1) guard hairs, (2) fine hairs, and (3) tactile hairs.

Guard hairs are long, coarse hairs that make up the outer coat. They repel water and help protect the dog from rain and snow. Fine hairs make up the undercoat, which helps keep the animal warm. Although dogs normally shed some hairs continuously, most dogs shed their undercoat in the spring and regrow it in the fall. Tactile hairs, also called whiskers, are highly sensitive touch organs on the muzzle and cheeks and over the eyes. These tactile hairs may help dogs find their way in dim light.

The texture and length of the coat differ greatly among breeds. Boxers and miniature pinschers have a short, fine coat. The maltese, borzoi, and Afghan hounds have long, silky fur. Poodles, Bedlington terriers, and Kerry blue terriers have coarse, curly coats. Some breeds, such as the Samoyed, provide fur from which yarn is made and woven into clothing.

A dog's coat may be made up of several colors, and members of the same breed may have differently colored coats. For example, a Labrador retriever may be light yellow, dark yellow, chocolate brown, solid black, or black with tan markings.

Senses. A dog's most highly developed senses are those of smell and hearing. Dogs can smell odors that the human nose is unable to detect. A dog can pick out an object that has been briefly held by a person from a group of identical objects that have not been touched. Some dogs, such as bloodhounds, are able to follow scent trails more than four days old, under certain conditions.

Dogs can also hear much better than people. They can detect high-pitched sounds that are above the limit of human hearing. Dogs also hear at great distances, and they can easily determine the direction of a faint sound.

Dogs cannot see forms and patterns as well as people can, but their sight is highly sensitive to motion. A dog's color vision is mainly limited to shades of gray and perhaps blue. The colors green, red, yellow, and orange all look the same to dogs.

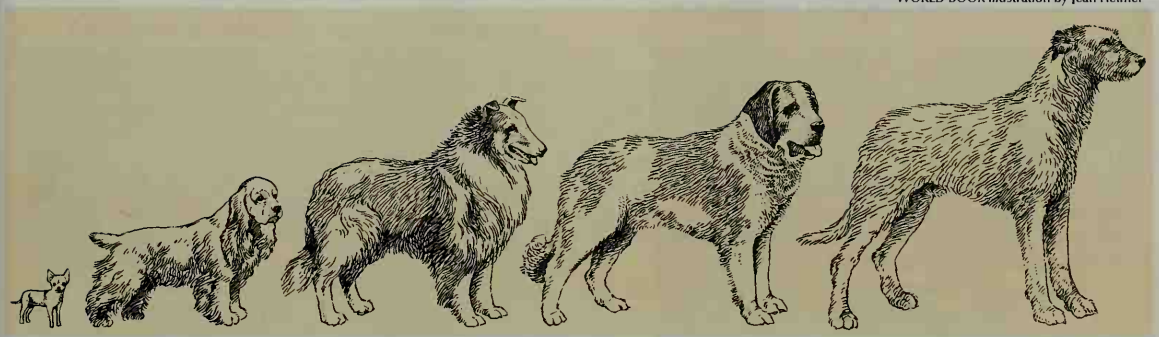
At the back of each eye, a dog has a mirrorlike structure called the *tapetum lucidum.* It reflects light and so helps the animal see in dim light. The tapetum lucidum makes dogs' eyes appear to glow in the dark when a light strikes them.

Kinds of dogs

There are more than 400 kinds of purebred dogs. A *purebred* is a dog whose *sire* (father) and *dam* (mother) belong to the same breed and whose ancestors were purebred from the time the breed was recognized. In developing a breed, individual dogs that exhibit desired

The sizes of dogs The Chihuahua is the smallest breed of dog. The St. Bernard is one of the heaviest breeds, and the Irish wolfhound is one of the tallest. Other breeds range in size between these extremes. The measurements for each dog pictured below are the average weight and shoulder height for the breed.

WORLD BOOK illustration by Jean Helmer



Chihuahua
1-6 lb (0.5-3 kg)
5 in (13 cm)

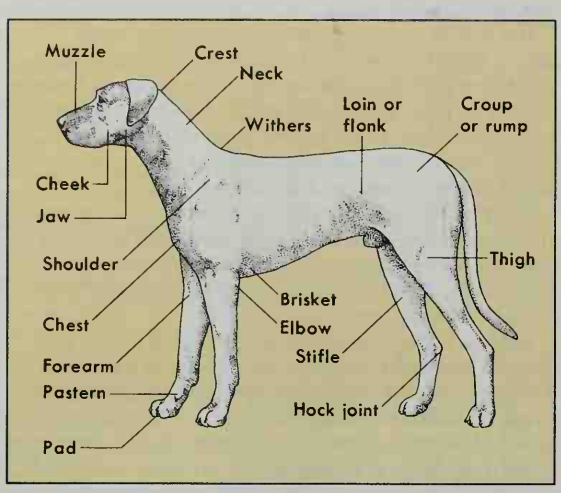
Cocker spaniel
22-28 lb (10-13 kg)
14-15 in (36-38 cm)

Collie
50-75 lb (23-34 kg)
22-26 in (56-66 cm)

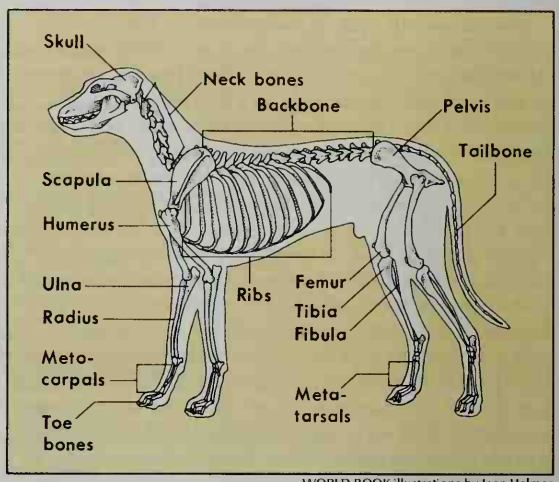
St. Bernard
165-200 lb (75-90 kg)
25 $\frac{1}{2}$-30 in (65-76 cm)

Irish wolfhound
126-145 lb (57-66 kg)
32-39 in (81-99 cm)

The body of a dog



The skeleton of a dog



WORLD BOOK illustrations by Jean Helmer

characteristics are mated. *Mixed-breed dogs,* also known as *mutts* or *mongrels,* have parents who belong to different breeds or who are of mixed breeding themselves.

Various organizations throughout the world keep records of dog breeding. In the United States, the best-known dog registry is the American Kennel Club (AKC). The Canadian Kennel Club in Canada and the Kennel Club in the United Kingdom have similar functions.

The AKC classifies dog breeds into seven major groups for exhibition in dog shows. The seven groups are: (1) sporting dogs, (2) hounds, (3) working dogs, (4) terriers, (5) toy dogs, (6) nonsporting dogs, and (7) herding dogs.

The AKC also has a miscellaneous category for dogs that are growing in popularity but that have not yet been accepted for registration. These breeds include the beauceron, the German pinscher, the Plott hound, and the toy fox terrier.

Sporting dogs were developed to assist hunters who use guns. Breeds in this group are also called *gundogs.* They include pointers, setters, retrievers, and spaniels. Pointers and setters point their body toward hidden game. Retrievers pick up birds that have been shot and bring them back to the hunter. Most spaniels, including cocker and springer spaniels, flush birds from the brush.

Hounds. Members of this group are breeds that were developed to hunt. Some breeds in the group, including beagles, basset hounds, and bloodhounds, are called *scent hounds* because they hunt by scent. Others, such as greyhounds, salukis, and whippets, were bred to hunt game by sight and are known as *gazehounds* or *sight hounds.* Some hounds were developed to catch and kill the prey. Others corner the game and hold it at bay until the hunter arrives to kill it.

Working dogs. Members of this group vary greatly in size and in the purposes for which they were developed. Working dogs include breeds developed for guarding and hauling. Alaskan malamutes, Samoyeds, and Siberian huskies pull sleds. St. Bernards and Newfoundlands were bred for rescue work.

Terriers. Breeds included in this group were originally developed to dig into the earth to pursue prey. In the past, they specialized in hunting rodents and other small animals, such as badgers and rabbits. Some terriers were used for dogfighting before such contests were generally banned as cruel.

Toy dogs consist of small breeds kept almost entirely as pets. Small varieties of poodles and Manchester terriers also compete in the toy group at dog shows. The largest toy dog is the pug, which may weigh up to 18 pounds (8 kilograms).

Nonsporting dogs. Members of this group are large companion dogs that may have originally been developed for work or sport. Poodles, for example, once retrieved ducks for French hunters, and bulldogs were bred for a sport called bull-baiting.

Herding dogs. Members of this group were classified in the working group until the AKC created a new group for herding breeds in 1983. All of these breeds were developed to keep sheep and cattle from straying and to protect livestock from predators. The herding group includes such popular pet breeds as the collie and the German shepherd dog.

The life of a dog

Life history. A female dog carries her young for about nine weeks before they are born. The number of puppies in a litter is determined mainly by the size of the mother. Small breeds usually have 1 to 4 puppies, medium breeds have 4 to 8, and large breeds have 6 to 10.

Puppies are helpless at birth. They cannot see until their eyelids open about 10 to 15 days after birth. Their ear canals also remain sealed for two to three weeks. A newborn pup cannot empty its bladder or bowels unless its mother licks the area under the base of its tail. Puppies normally begin walking just after 2 weeks and become steady on their feet when they are 3 weeks old. At that age, they also begin to bark and wag their tails.

Like other mammals, puppies live solely on their mother's milk at first. Most pups begin to eat solid food

(This section continues on page 277.)

Working dogs

The breeds of working dogs registered by the American Kennel Club serve people in various ways. For example, Doberman pinschers make excellent guard and police dogs. Alaskan malamutes, Samoyeds, and Siberian huskies pull sleds, and St. Bernards and Newfoundlands were bred for rescue work.

WORLD BOOK photo

Alaskan malamute

WORLD BOOK photo

Newfoundland

WORLD BOOK photo by Ira Spring

Bernese mountain dog

WORLD BOOK photo by Ken Love

Samoyed

WORLD BOOK photo

Boxer

WORLD BOOK photo

Great Pyrenees

WORLD BOOK photo by Brent Jones

St. Bernard

WORLD BOOK photo

Mastiff

Sporting dogs

Sporting dogs registered by the AKC consist of breeds of pointers, setters, retrievers, and spaniels. Pointers and setters use their sharp eyesight and keen sense of smell to find birds. They then point their bodies toward the game to guide the hunter. Retrievers pick up birds that have been shot and bring them back to the hunter. Retrievers can work on land, but they mainly retrieve birds from the water. Most spaniels help hunters by going into bushes or brush to *spring* (scare) birds into the air. Unlike other spaniels, the Irish water spaniel retrieves ducks and other birds from the water.

WORLD BOOK photo

Chesapeake Bay retriever

WORLD BOOK photo by Ken Love

English setter

WORLD BOOK photo by Dave G. Wacker

Golden retriever

WORLD BOOK photo by Brent Jones

Pointer

WORLD BOOK photo by Dave G. Wacker

Irish water spaniel

WORLD BOOK photo by Isac Jo

Labrador retriever

WORLD BOOK photo

Brittany

WORLD BOOK photo by Isac Jo

Vizsla

WORLD BOOK photo by Brent Jones

Weimaraner

WORLD BOOK photo by Brent Jones

English cocker spaniel

WORLD BOOK photo

Cocker spaniel

WORLD BOOK photo by Brent Jones

English springer spaniel

WORLD BOOK photo

Gordon setter

WORLD BOOK photo by Joe Clark

American water spaniel

WORLD BOOK photo by Ken Love

Irish setter

Ralph A. Reinhold, Animals Animals

German shorthaired pointer

Hounds

The AKC registers various breeds of hounds. Hounds hunt either by smell or by sight. *Scent hounds,* such as beagles and foxhounds, run with their noses to the ground to follow an animal's scent. While they are trailing game, coonhounds and some other kinds of scent hounds *bay*—that is, they give out deep, long barks. Tall, slender *gazehounds,* or *sight hounds,* were bred to hunt game by sight. Today, such gazehounds as greyhounds and whippets are used in dog racing.

Marshall P. Hawkins

American foxhound

WORLD BOOK photo

Irish wolfhound

WORLD BOOK photo by Ken Love

Norwegian elkhound

WORLD BOOK photo by Ken Love

Rhodesian ridgeback

WORLD BOOK photo by Ken Love

Greyhound

WORLD BOOK photo

Dachshund (wire-haired)

WORLD BOOK photo

Borzoi

Hans Reinhard, Bruce Coleman, Inc.

Beagle

WORLD BOOK photo by Ken Love

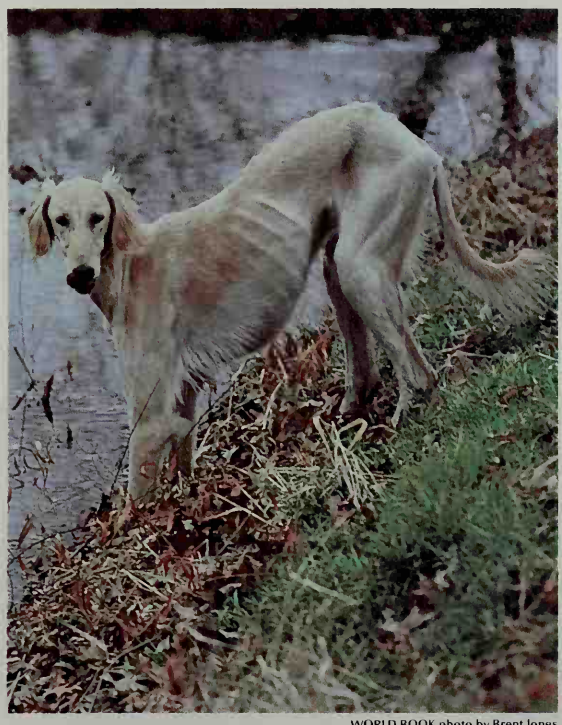
Whippet

WORLD BOOK photo by Brent Jones

Basset hound

WORLD BOOK photo by Brent Jones

Black and tan coonhound



WORLD BOOK photo by Brent Jones

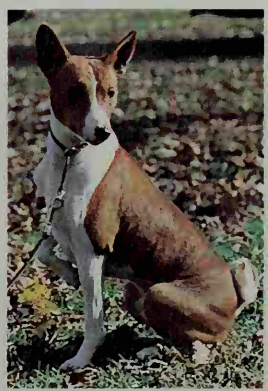
Saluki

WORLD BOOK photo by Ken Love

Afghan hound

WORLD BOOK photo

Bloodhound



WORLD BOOK photo by Brent Jones

Basenji

Terriers

There are a number of breeds of terriers recognized by the American Kennel Club. Terriers were originally bred to drive game out of holes in the ground. Their name comes from *terra,* the Latin word for *earth.* Most of the terrier breeds originated in England. The majority of terriers have a wiry coat and a bushy beard. Terriers make fearless watchdogs. They also help people by killing mice, rats, and other pests.

WORLD BOOK photo by Ken Love

Irish terrier

WORLD BOOK photo by Ken Love

Airedale terrier

Libwyre Kennel

Wire fox terrier

WORLD BOOK photo by Brent Jones

Manchester terrier

WORLD BOOK photo by Dave G. Wacker

Skye terrier

WORLD BOOK photo by Ken Love

Welsh terrier

WORLD BOOK photo by Isac Jo

Bull terrier

WORLD BOOK photo by Walter Chandoha

Australian terrier

WORLD BOOK photo

American Staffordshire terrier

William P. Gilbert

Miniature schnauzer

WORLD BOOK photo

Bedlington terrier

WORLD BOOK photo by Ken Love

Cairn terrier

WORLD BOOK photo by Brent Jones

Sealyham terrier

WORLD BOOK photo by Ken Love

Scottish terrier

WORLD BOOK photo

Smooth fox terrier

WORLD BOOK photo by Dave G. Wacker

Kerry blue terrier

Toy dogs

Toy dogs consist of small breeds kept as pets. In addition to these breeds, small varieties of poodles and Manchester terriers also compete in the toy group at dog shows.

Toy breeds come from all parts of the world. For example, the Chihuahua was developed in Mexico, the Pekingese in China, and the papillon in Spain. The largest toy dog is the pug, which may weigh up to 18 pounds (8 kilograms).

WORLD BOOK photo by Brent Jones

Yorkshire terrier

WORLD BOOK photo

Maltese

WORLD BOOK photo

Brussels griffon

WORLD BOOK photo

Shih Tzu

WORLD BOOK photo

Pug

WORLD BOOK photo

Pekingese

WORLD BOOK photo

Miniature pinscher

WORLD BOOK photo

Pomeranian

WORLD BOOK photo

Affenpinscher

WORLD BOOK photo

Chihuahua

Nonsporting dogs

Nonsporting dogs consist of breeds kept chiefly as pets. Many were originally bred for work or sport. Poodles, for example, once retrieved ducks for French hunters. People have used Dalmatians for many purposes, including herding cattle and hunting game. The Boston terrier is the only nonsporting breed that originated in the United States. Breeders developed the first Boston terriers by mating bulldogs with terriers.

WORLD BOOK photo by Ken Love

Keeshond

WORLD BOOK photo by Dave G. Wacker

Bulldog

WORLD BOOK photo

Poodle

WORLD BOOK photo

Schipperke

WORLD BOOK photo by Brent Jones

Boston terrier

WORLD BOOK photo by Ken Love

French bulldog

Mary Bloom © American Kennel Club

Lhasa apso

WORLD BOOK photo

Tibetan terrier

WORLD BOOK photo by Brent Jones

Dalmatian

Herding dogs

There are a number of breeds of herding dogs recognized by the AKC. Historically, these hardy dogs were used to keep grazing cattle and sheep from straying, and to protect the livestock from wolves. Herding dogs also helped drive cattle and sheep to market. Many of these breeds are still popular as farm animals. This group includes some of the most popular pet breeds, such as the collie.

WORLD BOOK photo by Michael D. Sullivan

Australian cattle dog

WORLD BOOK photo

Collie

WORLD BOOK photo by Ken Love

Shetland sheepdog

WORLD BOOK photo by Brent Jones

Pembroke Welsh corgi

© Reynolds Photography

Canaan dog

© John Daniels, Bruce Coleman Inc.

Polish lowland sheepdog

WORLD BOOK photo by Brent Jones

Old English sheepdog

Robert L. Harris, Briard Club of America

Briard

(continued from page 266.)

at about 3 weeks of age and stop nursing by 6 weeks.

It is important for puppies to have contact with human beings if they are to become good pets. Newborn puppies should be handled gently for a few minutes each day. Between 4 and 10 weeks of age, pups need even more human contact or they will never relate well to human beings. The best time to adopt a new puppy is when it is 6 to 8 weeks old. Contact with other dogs is also important for puppies, or the dog may grow up to be too aggressive or too shy with other dogs.

Many puppies reach their adult height by 6 months of age but may continue to gain weight until 1 or 2 years old. Dogs often become sexually mature before they are fully grown. For small breeds such as the chihuahua, this may be as early as 5 months to 6 months old. For giant breeds, it may be as late as 1 $\frac{1}{2}$ years.

The length of a dog's life depends on its *genes,* the biological structures that carry specific traits from one generation to the next, as well as the care the dog receives. In general, small breeds live longer than large ones. It is not unusual for a toy poodle or pug to live 15 to 16 years. Giant breeds, such as the Great Dane and St. Bernard, are considered old at 8 or 9. Dogs that eat a healthful diet, get regular exercise, and receive good medical care usually live longest. The longest life span ever recorded for a dog was 29 years 5 months, for an Australian cattle dog. Because dogs mature at different rates, it is difficult to compare their ages directly to those of human beings.

Behavior. Much of a dog's behavior is *instinctive*—that is, inherited rather than learned. For example, the digging and circling motions a dog performs before lying down, and the tendency to bury bones, are instinctive actions. Dog behavior resembles that of dogs' closest wild relatives, wolves, who live and hunt in packs.

Dogs use various vocal sounds, including barks, yelps, whines, howls, and growls, to communicate with other dogs and with people. These sounds mean different things in different situations. For example, whining may indicate pain when a dog is injured or merely anxiety when the dog is separated from its owner.

Dogs also communicate through *body language* (body and tail postures and facial expressions). For example, a dog uses a direct stare as a threat or challenge. But a dog will break eye contact as a sign of surrender to a more *dominant* (powerful) dog or person.

Still another means of communication involves scents. Both male and female dogs use urine to mark their territory. A pair of glands called the *anal sacs* appear near the *anus,* the external opening of the intestine at the dog's rear end. These sacs produce a strong-smelling fluid that marks the dog's bowel movement with an identifying odor. If a dog is frightened, the anal sacs may empty explosively, releasing a strong, unpleasant odor.

Dogs instinctively regard their owner's house, yard, and the surrounding area as their own territory and will defend it against intruders. They do this by barking and sometimes by biting. Some dogs will also bite if they are cornered by a stranger who does not give them a means to escape.

People can avoid dog bites by never approaching strange dogs. If you must get close to an unfamiliar dog, it is important to understand the dog's body language. The danger of a bite is greatest if the dog stands stiffly with its tail and ears erect and the fur on the back of its shoulders raised. It may bare its teeth and bark, growl, or both. Never stare directly into a strange dog's eyes because it may consider your stare a threat and attack you. Instead, avoid eye contact, keep arms down, and slowly back away. Do not turn around to leave or run because this may trigger the dog's instinct to chase you.

WORLD BOOK photo

A mother nurses her puppies until they are about 6 weeks old. Most litters consist of 1 to 12 pups, but litters of 15 or more have been reported. These dogs are Chesapeake Bay retrievers.

When introduced to a new dog, even one that appears friendly, be cautious. Kneel down to its level and let it approach you and sniff the back of your closed hand. Do not move suddenly, reach over the dog's head, or stand over the dog. A dog that approaches with its body relaxed and its tail wagging is probably friendly even if it is barking. Many dogs bark as a greeting.

Choosing a dog

The decision to bring a dog into your home should involve serious consideration. Dogs are highly social animals. To be happy, they need the company of people, other animals, or both. If you do not have the time to give a dog the love and care it needs, then you should select a pet that needs less attention. Dogs often live for 10 to 15 years. If you cannot assume responsibility for care during the whole lifetime of a dog, it is better not to choose one for a pet.

After you are sure that you can give a dog a good home, you should decide what kind of dog would be best for you. Your dog's personality should suit your own. If you live in a house or apartment without a large yard, consider a small dog that needs relatively little exercise. Look for a dog that will weigh less than 25 pounds (11.3 kilograms) when fully grown. A small dog can usually get all the exercise it needs if it has the run of an apartment and is taken for walks outside. Larger breeds usually require more space.

Small dogs eat less. Giant breeds often need as much food as an adult human being and are, therefore, more expensive to feed.

Dogs with short hair usually need little grooming. Long-haired dogs need more. Several breeds, such as

poodles, require more extensive grooming, especially if the dog participates in dog shows. Therefore, it is important to investigate the amount of required grooming for any dog you consider and decide whether you can spend the time and money to provide it.

The chief advantage of selecting a purebred pup is that you know how the dog will look when it is grown. Purebred dogs, however, suffer from many inherited diseases. For this reason, you should buy a purebred dog only from an experienced breeder with a good reputation. You should also find out as much as you can about the dog's parents and their ancestors. Visit dog shows and talk with the exhibitors to get information about the kind of dog you would like. A veterinarian may also recommend good breeders and help you choose a healthy dog.

The best thing about mixed-breed dogs is that each one is unique. Mutts come in every size, shape, and color. However, it may be difficult to predict the adult size and appearance of a mixed-breed puppy. Humane societies and animal shelters have good selections of mixed-breeds. Veterinarians, computer pet hot lines, and newspaper advertisements may also lead you to a fine pet.

When considering a puppy, visit its kennel or home and observe one or both of the parents if possible. Both the pup and its parents should be obviously healthy. Look for bright eyes, clean ears, sweet breath, and a shiny coat. The nose, eyes, and ears should be free of any discharge. The pup's teeth should be straight. A normal puppy moves freely, without limping, and is active and playful. A dog that shrinks into a corner may be sick or overly shy.

Caring for a dog

Feeding. Dogs require different kinds of foods during the various stages of their lives. At about 3 to 4 weeks of age, puppies need to supplement their mother's milk with solid food. Provide a good-quality commercial product, either dry or canned, that is labeled as food for puppies. Soften dry food by moistening it with water or a puppy milk-replacement formula, or by mixing it with canned food, to make it easier for young pups to chew. You may also give a puppy cooked eggs and cottage cheese, but these foods should make up no more than 10 to 20 per cent of the dry weight of the puppy's diet.

Both puppies and adult dogs can be fed by either the *self-feeding* or the *portion-controlled* method. In self-feeding, also called *free feeding,* the owner leaves food where the dog can get it and replaces the food as often as necessary to keep it fresh. A dog fed this way can eat at will.

In the portion-controlled method, also called *hand-feeding,* the dog receives enough food to leave it comfortably full at regular intervals. The owner allows about 20 minutes for a meal, then removes any remaining food until the next mealtime. A puppy should be fed four times a day until it is about 3 months old. The pup should then eat three times a day until it is 6 months old, then twice a day until it is fully grown. Adult dogs need only one meal a day, but many dogs prefer two smaller meals, one in the morning and one at night.

Provide fresh, clean water at all times in a bowl that your pet cannot tip over. Avoid feeding large amounts of meat and table scraps to dogs. Dogs fed these foods quickly develop a preference for them and may develop dietary imbalances and deficiencies. Vitamin and mineral supplements are unnecessary for healthy dogs who eat a complete, balanced diet.

Bone chewing is natural for dogs, but it can cause broken teeth, and splinters of bone may cause digestive upsets or internal injuries. For these reasons, many veterinarians recommend offering rawhide strips or special chew toys instead of bones. Old dogs and dogs with certain medical conditions such as heart or kidney disease may require special diets. Your veterinarian will advise you when special food is needed.

Sleeping quarters. A dog bed may be as simple as a cardboard box lined with clean shredded paper or washable towels or blankets. All bedding should be replaced or washed frequently to avoid problems with fleas. Many veterinarians and dog breeders recommend a shipping crate or kennel for the dog's bed. Dogs who sleep in such an enclosure adjust well if they must be confined for shipping, boarding, or hospitalization.

Dogs kept outdoors need a shelter that is waterproof and insulated from heat and cold. A garage, barn, or shed may serve, or you may buy or build a special doghouse. In any case, the door should keep out wind, rain, and snow, and the doghouse should be raised off the ground to protect the floor from cold and moisture. The house should be shaded from the sun in hot weather. In cold weather, even a well-insulated shelter may need a heat lamp or other source of warmth.

Grooming prevents skin problems by keeping a dog's coat clean and free from fleas and ticks. The kind and amount of grooming needed is determined by the dog's fur type and length and by the animal's life style. In general, dogs with longer fur need more frequent combing and brushing than those with short coats. Pets who spend a lot of time outdoors usually need more frequent grooming than those who live mostly indoors. Dogs also need regular ear inspection and cleaning, toenail trimming, and tooth inspection and cleaning.

A mistaken idea held by many pet owners and some veterinarians is that a dog should be bathed as seldom

WORLD BOOK photo

Careful grooming helps keep a dog's coat clean and free of loose hair. The Siberian husky shown above is receiving a final brushing before being exhibited in a dog show.

as possible. In fact, you may wash your dog as often as necessary—in many cases, once a week. You must, however, use a special shampoo that does not strip the oils from the dog's coat.

When you give your dog a bath, carefully pour warm water over your pet. Apply a gentle shampoo and lather well. You may choose to shampoo the dog's head first, followed by the body, legs, and feet, or wait and shampoo the head last. Be careful not to get any shampoo in your dog's eyes. Rinse thoroughly because any soap that remains on the skin may cause itching. After the bath, apply a flea or tick control treatment as recommended by your veterinarian.

Exercise and play. Like human beings, dogs need exercise to remain physically fit and mentally healthy. The easiest way to exercise a dog is to release it in an enclosed space with another friendly dog. Dogs left alone may not remain active long enough to stay in shape. A dog will also benefit from daily brisk walks or jogs with its owner. Be sure to confine your dog to a leash if you walk or jog where there is traffic or if your city has a leash requirement.

Playing with your dog is another good way to keep it physically fit. A game of fetch is a favorite of many dogs. You can get ideas for other kinds of play by adapting the games dogs play with one another, such as chase, tag, and wrestling.

A dog invites another dog to play by assuming a posture called the *play bow.* The dog stands with its hind legs straight while bending down with its front legs and wagging its tail. Sometimes barking accompanies the invitation. The dog may alternate bowing with short jumps forward and hops backward. You can imitate the play bow by getting down on your hands and knees and stretching your arms forward on the ground.

Medical care. Common signs of illness in dogs include a change in behavior, a change in appetite, and fever. Most animals become less active when they are sick or injured. Dogs may refuse to eat when they are ill, or they may just eat less. Some illnesses actually cause a dog to eat or drink more. Any change of appetite that lasts for more than a few days calls for a veterinary examination. If there are other signs of illness such as vomiting, diarrhea, sneezing, or coughing, take your pet to a veterinarian as soon as possible. A dog that repeatedly scratches its ears or shakes its head may have an ear infection, especially if there is a foul-smelling discharge from the ears. If your dog has these symptoms, a veterinarian should check its ears.

If you suspect your dog is sick, you can take its temperature with a rectal thermometer. A temperature above 102.5 °F (39.2 °C) is a fever and requires a veterinarian's consultation. Sometimes dogs with a fever have a dry nose, but this is not a reliable way to judge whether a dog is sick.

Every new puppy should be taken to a veterinarian for a checkup and vaccinations. All pups should be vaccinated against common dog diseases, including canine distemper, canine hepatitis, leptospirosis, canine parvovirus, and canine parainfluenza. Veterinarians commonly vaccinate against all these infections with a combination shot known as the DHLPP (*d*istemper *h*epatitis *l*eptospirosis *p*arvovirus *p*arainfluenza). Puppies need a series of DHLPP injections beginning when they are 6 to 8 weeks of age and ending when they are just over 4 months old. Adult dogs should also be taken to the veterinarian yearly for a checkup. Booster shots, which maintain protection against these serious diseases, are given as needed every one to three years.

Another deadly disease that strikes dogs is rabies, which is usually transmitted by the bite of infected animals. A dog with rabies may bite and infect human beings. Puppies should receive a rabies vaccination at 3 to 4 months of age. The frequency of vaccination then depends on state law and the type of vaccine used. In most states, dogs need a rabies booster shot one year after the first vaccination, then every three years after that.

Parasitic worms cause health problems for many dogs. Many puppies are born with roundworms. To prevent spreading the parasites to other dogs and people, veterinarians recommend deworming pups with medication every two to three weeks until they are 3 to 4 months of age. A dog may acquire tapeworms by swallowing an infected flea or by eating raw fish or meat. Prevent tapeworm infection by good flea control and by letting your dog eat only wholesome, cooked foods.

A parasite called the *heartworm* may cause serious illness or even death. Adult heartworms live in the dog's heart, but young forms of the worm are found in the blood. Mosquitoes transmit the infection after they feed on the blood of an infected dog and then bite another dog. All dogs in mosquito-infested areas should receive medicine to prevent heartworms. A dog's annual checkup should include examinations for heartworms and other worms.

Social and moral responsibilities. The privilege of owning a dog is accompanied by many responsibilities beyond providing proper care. Some of these responsibilities are enforced by the laws of certain communities. For example, many cities have laws that require dogs in public areas to be kept on a leash. Leash laws protect both the dog and the public. Unleashed dogs may dart into the street and be hit by cars. Dogs who run free may also bite people or fight with other dogs. In rural areas, free-roaming dogs may chase and injure wildlife and livestock. They may also eat poison, become caught in traps, or be shot by hunters or farmers.

Responsible dog owners clean up after their pet has a bowel movement. Some towns and cities fine owners who do not clean up after their dog.

Considerate owners make sure their dog does not disturb other people by barking or howling too much. Most dogs who are properly trained, well exercised, and given enough social contact do not make excessive noise.

Dog owners also have a moral and social responsibility to keep their pets from reproducing randomly. Each year, millions of healthy dogs are killed in animal shelters and pounds because homes for them cannot be found. This terrible overpopulation problem could be eliminated if more people prevented their dogs from having unwanted puppies.

Female dogs can become pregnant during *estrus* or *heat,* a period in which they are sexually receptive. This period usually occurs twice a year and lasts about two or three weeks. It is easy for an owner to prevent pregnancy in a female pet. The owner can keep the pet on a leash and can supervise her whenever the dog is out-

doors until estrus has passed. A veterinarian can permanently prevent pregnancy by an operation that removes the female reproductive organs. This procedure is called an *ovariohysterectomy* or *spaying.* Most veterinarians recommend this surgery be done before the puppy's first heat cycle at about 6 months of age. Many animal shelters and some veterinarians encourage or require the surgery at a younger age.

Male dogs can mate with numerous females, so it is irresponsible to allow them to roam unsupervised. An operation called *castration* makes a male dog permanently unable to father pups. This surgery may be performed on young puppies, but many veterinarians prefer to wait until the dog is 6 months old to allow fuller body development.

Training a dog

All dogs need training to live happily and successfully with human owners. Dogs learn most quickly if given rewards instead of punishment. It is also important to be consistent. Dogs who are sometimes corrected and other times allowed to misbehave may become confused and unruly.

Housetraining, also called *housebreaking,* should begin as soon as you get your puppy. The process will normally take until the pup is at least 12 weeks of age. To housetrain your dog, confine it to a small area at night and whenever you leave it alone. You might use a small room, part of a room, a large box, or a shipping kennel or crate. The area should be just large enough to hold the pup's bed, a newspaper-covered spot, and a water bowl. This method is called *crate, den,* or *den-bed training.* A pup confined in such an area will wait as long as possible to urinate or move its bowels because of a natural reluctance to soil its own bed.

Take your puppy out first thing in the morning, whenever it awakens from a nap, and after eating. Most dogs need to empty their bladder and bowels at these times. Give your puppy its last meal of the day early in the evening and take the dog out before bed. Whenever you take your pup out, stay with it until it urinates, has a bowel movement, or both. Then praise the dog for doing the right thing in the right place. This is the most important key to housetraining.

Correct your dog only when you catch it urinating or emptying its bowels in the wrong place. If possible, snatch the dog up in the middle of the act with a "No!" Take the pup outdoors to finish in an appropriate toilet area so you can give praise. It is useless to punish a housetraining error several hours after the act.

Obedience training can also begin as soon as you get a new puppy. The first lesson your dog should learn is to let people handle it. Be sure to touch all parts of your pup's body and look in its ears and mouth. Dogs who learn to tolerate or even enjoy such handling are easier to care for if they become sick. They are also less likely to bite people who try to touch them.

The first simple command to teach a dog is "No." When your dog starts to do something it should not do, say "No" in a firm voice. In most cases, your command will startle the dog and it will stop whatever it was doing. When this happens, quickly say "Good dog" in a friendly, happy tone as a signal that your dog has done well. Always give correction or praise immediately.

WORLD BOOK photo by Brent Jones

Obedience training classes like the one above are conducted by dog clubs and other organizations. With proper training, almost any dog can become an obedient companion.

Most dogs do not need physical punishment to learn the meaning of "No." But if your dog does not respond to your voice alone, you can combine the "No" command with actions that imitate how the leader of a wolf pack disciplines pack members. For example, you might grasp your pup by the scruff of the neck and shake it gently or lift it slightly off the ground. Alternatively, use the neck hold to push a pup's head toward the ground.

If your pet seems slow to realize what "Good dog" means, give the dog a treat, such as a bit of dog cookie, as you say the words. Dogs learn quickly when they are rewarded with food. Later, you can give the food reward less frequently until your dog responds to praise alone.

A good place for a puppy to learn to get along with other dogs is in a special socialization class. Dog trainers, veterinarians, and obedience clubs in many cities offer such instruction, often called puppy classes or puppy kindergarten. The owner learns how to train the pup, and the puppy is taught to sit, lie down, stand for examination, come, walk at heel, and stay. After graduating from puppy class, a dog is ready for more advanced obedience lessons.

Dog competitions. Kennel clubs in many countries sponsor dog shows. At these competitive events, dogs are evaluated on their physical appearance. In the United States, the AKC regulates most dog shows, and dogs must be AKC registered to compete. The club maintains official descriptions of each dog breed called *breed standards.* Breed standards include such details as the size and shape of the dog's body and the color and texture of its coat. Other characteristics include temperament, type of movement, and how the coat must be trimmed. Show judges award points based on how closely an animal meets the breed standard.

In an all-breed dog show, judges first select the best member of each recognized AKC breed. These dogs then compete against one another to be chosen best in each of the seven major groups of dogs. From these seven dogs, the judges name one as "best in show."

At some dog shows, called *bench shows,* handlers must display their dogs in stalls mounted on benches when they are not competing in the show ring. The Westminster Kennel Club of New York City holds the most important bench shows in the United States in

February at Madison Square Garden. The shows have been held annually since 1877.

Other competitive events for dogs include *obedience trials, field trials, agility trials,* and *dog sports.* Obedience trials test how people and dogs work together. Any recognized breed may compete, and appearance is not a factor in awarding points. Exercises at these trials may include jumping, retrieving, and scent discrimination.

Field trials are competitions for hunting breeds. Hounds are judged on their ability to pursue rabbits or hares by scent. Pointing breeds must stop and point when they scent a game bird planted in the trial field. Retrievers must fetch from both water and land. Spaniels must locate planted game, flush birds into the air, and retrieve on command.

Agility trials and dog sports competitions are open to mixed breed dogs as well as purebreds. They highlight a dog's athletic ability and may include tests of climbing, tunnel running, and ball or frisbee catching.

History

Scientists believe that dogs developed from a weasel-like, meat-eating animal called *Miacis,* which lived about 50 million years ago. *Miacis* was the ancestor not only of dogs but also of cats, bears, raccoons, civets, weasels, and skunks. A descendant of *Miacis* called *Tomarctus* appeared about 15 million years ago. *Tomarctus* resembled a wolf and is the direct ancestor of all members of the dog family, including wolves, coyotes, jackals, foxes, and domestic dogs.

The oldest sites where fossilized human and dog remains occur together date between 12,000 and 11,000 years ago. Based on this evidence, scientists believe that dogs, as we know them today, and people have lived with each other for at least 14,000 years. Thus dogs rank as the oldest known domesticated animal. The saluki, probably the oldest present-day breed, may have originated in the Middle East as early as 7000 B.C. Paintings and sculpture from ancient Egypt indicate that the Egyptians had developed various dog breeds by about 1500 B.C. These artworks depict heavy dogs resembling mastiffs and hunting dogs with long legs and pointed noses.

The English physician John Caius, who also used the name Johannes Caius, wrote one of the first books about dogs in 1570. Caius describes 16 breeds, including terriers, spaniels, setters, bloodhounds, greyhounds, shepherds, and mastiffs. The first kennel clubs formed in Europe in the 1800's, and the first formal dog show took place in England in 1859 at Newcastle upon Tyne.

Dave G. Wacker

Field trials test the hunting ability of dogs. This Chesapeake Bay retriever is being rated on how quickly it found a bird that a hunter had shot and whether it returned the bird undamaged.

Terri McGinnis

Scientific classification. Dogs belong to the family Canidae.

Related articles in *World Book* include:

Recognized breeds of purebred dogs

See the separate article for each breed listed in the table *Breeds of purebred dogs recognized by the AKC* in this article.

Other dogs

Hound	Pit bull	Sled dog	Toy dog
Mexican hairless	Police dog	Spitz	Wolfhound
	Sheepdog	Terrier	

Dog family

Coyote	Dingo	Jackal	Wolf
Dhole	Fox		

Other related articles

American Kennel Club	Hunting (Kinds of hunting)
Breeding	Pedigree
Canine parvovirus	Pet
Distemper	Rabies
Dog guide	Society for the Prevention of Cruelty to Animals
Dog racing	
Humane society	United Kennel Club

Outline

I. The body of a dog
- A. Body structure
- B. Coat
- C. Senses

II. Kinds of dogs
- A. Sporting dogs
- B. Hounds
- C. Working dogs
- D. Terriers
- E. Toy dogs
- F. Nonsporting dogs
- G. Herding dogs

III. The life of a dog
- A. Life history
- B. Behavior

IV. Choosing a dog

V. Caring for a dog
- A. Feeding
- B. Sleeping quarters
- C. Grooming
- D. Exercise and play
- E. Medical care
- F. Social and moral responsibilities

VI. Training a dog
- A. Housetraining
- B. Obedience training
- C. Dog competitions

VII. History

Questions

What are a dog's two most highly developed senses?
Why should a person never stare at a strange dog?
What is the only dog that cannot bark?
Why do dogs' eyes seem to glow in the dark?
What is the main advantage of buying a purebred puppy?
About when did dogs and people first live together?
What are dewclaws?
When is the best time to adopt a new puppy?
What is the smallest breed of dog?
How does a dog invite another dog to play?

Additional resources

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Dog guide is a dog specially trained to guide a blind person or to alert a hearing-impaired person to important sounds. Dogs that guide blind people are called *guide dogs* or *seeing eye dogs,* and those that assist hearing-impaired people are called *hearing dogs* or *hearing ear dogs.* Dogs chosen for either kind of training must show qualities of good disposition, intelligence, physical fitness, and responsibility. Breeds best suited for guide dog work include, in order of importance, German shepherds, Labrador retrievers, and golden retrievers. Hearing dogs are usually mixed breeds selected from animal shelters.

Dog guide users have rights of equal access in almost all states of the United States and in all provinces of Canada. They may be accompanied by their dog guides in all public places, including stores, restaurants, and hotels; and on all forms of public transportation. A guide dog can be recognized by its special harness attached to a U-shaped handle. A hearing dog can usually be recognized by its bright orange or yellow collar and leash.

Guide dogs. For the first year of their lives, most future guide dogs live with families. They learn basic obedience and get used to such experiences as living with people and pets, riding in automobiles and other transportation, and visiting public places. At the age of about 14 months, a guide dog begins an intensive course that lasts from three to five months. It becomes accustomed to the leather harness and the stiff handle it will wear when guiding its blind owner. The dog learns to watch traffic and to cross streets safely. It also learns to obey such commands as "forward," "left," "right," and "sit," and to disobey commands that might lead its owner into danger. For example, a guide dog will refuse to cross a street unless traffic has stopped.

The most important part of the training course is a four-week program in which the dog and its future owner learn to work together. However, many blind people are unsuited by temperament to work with dogs. Only about a tenth of blind people find a guide dog useful.

The organized training of guide dogs began in Germany during World War I (1914-1918). The first guide dog school in the United States, The Seeing Eye, Incorporated, was founded in 1929. Other schools in the United States include Guide Dogs for the Blind, Incorporated; Guiding Eyes for the Blind; and Leader Dogs for the Blind.

Hearing dogs begin training between the ages of 8 months and 16 months. In addition to basic obedience, the dogs learn to alert their owners to such common sounds as alarm clocks, doorbells, and telephones, and to sounds that may warn of danger, such as crying babies and smoke alarms. Training is usually completed in three to four months. At the end of the course, the dog's trainer teaches the new owner how to care for the dog and keep it well trained.

The American Humane Association began the first national hearing dog program in 1976. Since then, several

E. James Pitrone, The Seeing Eye, Inc.

A dog guide leads its blind owner. These dogs are trained to avoid obstacles and dangerous situations, such as busy traffic.

© Judy Savage

A hearing dog alerts its owner to common sounds. The dog in this picture is being trained to respond to a cooking timer.

nonprofit organizations and some private organizations in the United States have begun such programs.

Critically reviewed by The American Humane Association

Dog racing, also called *greyhound racing,* is a sport in which greyhounds compete on an oval track. The dogs chase a mechanical lure that may resemble a bone, another greyhound, or a rabbit. Sometimes a wind sock is used. A mechanical lure is effective because greyhounds chase by sight rather than by scent. The lure moves around the track on an electric rail. Greyhound racing developed from *coursing,* an ancient sport in which two dogs chased a live rabbit over an open field.

Most dog-racing tracks are $\frac{1}{4}$ mile (0.4 kilometer) in length. Eight greyhounds compete over $\frac{7}{16}$, $\frac{3}{8}$, or $\frac{5}{16}$ of a mile (0.7, 0.6, or 0.5 kilometer). Champion dogs can run faster than 40 miles (64 kilometers) per hour.

Before each race, the dogs are put into individual stalls in a starting box. The lure is then started. When the lure is opposite the starting box, the doors of the stalls are opened, and the dogs are released. During the race, the lure is kept several yards ahead of the leading dog. The lure is moved out of sight of the dogs after they cross the finish line, and they stop running.

Dog racing is a popular sport in parts of the United States and in several other countries. Fans bet on the greyhounds through the pari-mutuel system. This system is also used in horse racing (see **Horse racing** [Betting]).

Critically reviewed by the American Greyhound Track Operators Association

Dog show. See **Dog** (Dog competition).

Dog sled. See **Sled dog.**

Dog Star. See **Sirius.**

Dogbane is the name of several closely related plants. Dogbanes grow primarily in the Northern United States and southern Canada. All the dogbanes are poisonous green plants that contain a milky bitter juice. But they are not very dangerous because most grazing animals dislike the bitter juice and will not eat them.

A common dogbane called the *spreading dogbane,* or *honeybloom,* has light-green leaves and clusters of pale pink flowers. This dogbane has a bitter root that physicians sometimes use to cause vomiting. Another dogbane called the *Canada hemp,* or *Indian hemp,* has greenish-white flowers that grow in clusters. The bark of this dogbane produces a long, strong white fiber that is used to make nets.

Scientific classification. Dogbanes belong to the dogbane family, Apocynaceae. The spreading dogbane is *Apocynum androsaemifolium.* The Indian hemp is *A. cannabinum.*

Jerry M. Baskin

WORLD BOOK illustration by Christabel King

Spreading dogbane

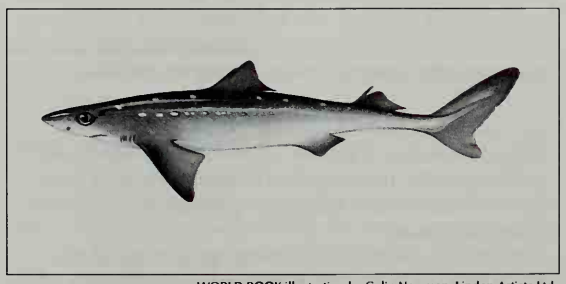
Doge, *dohj,* was the title of the rulers of Venice from 697 to 1797. *Doge* comes from the Latin word *dux,* meaning *leader.* Genoa also had doges.

The doges of Venice were elected for life from among the richest and most powerful families. They enjoyed almost absolute power in governmental, military, and church affairs until 1032. After that time, the people limited the doges' power by surrounding them with officials who could overrule them. In 1797, French troops led by Napoleon Bonaparte occupied Venice. Napoleon abolished the office of doge.

Paul F. Grendler

See also **Genoa; Venice** (picture).

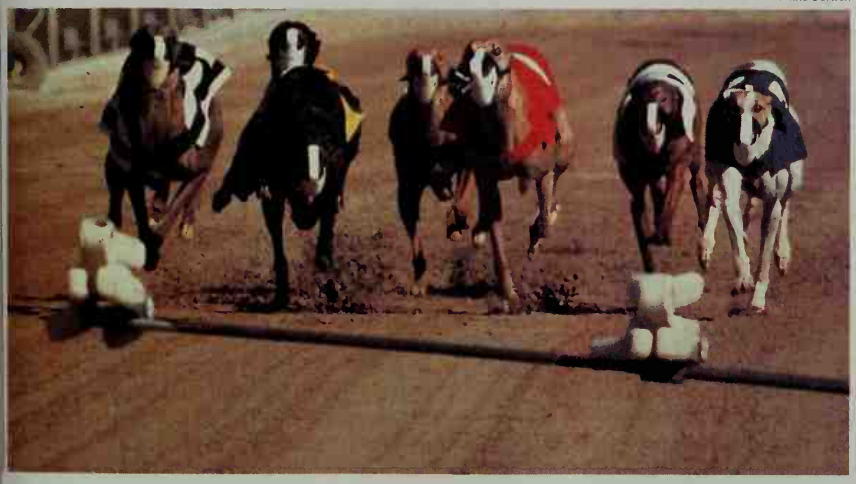
Dogfish is a type of small shark that lives in the ocean. There are about 70 species of dogfish. Most measure



WORLD BOOK illustration by Colin Newman, Linden Artists Ltd.

The spiny dogfish is a member of the shark family.

Mike Serlick



Dog racing is a sport in which greyhounds race around an oval track. They chase mechanical lures, *foreground,* that may look like rabbits. Spectators bet on the outcome of the races.

less than 5 feet (1.5 meters) long. However, the largest dogfish, the *Greenland shark,* can reach a length of over 20 feet (6 meters). The smallest, the *pigmy shark,* measures only about $\frac{1}{2}$ foot (0.2 meter) long.

The best-known dogfish is the *spiny dogfish.* This fish has sharp spines in front of its *dorsal* (back) fins. Spiny dogfish can be found along the Atlantic and Pacific coasts of North America, and the Atlantic coast of Europe. In Europe, especially in England, spiny dogfish are an important food.

One type of shark is sometimes called the *smooth dogfish.* However, the smooth dogfish does not belong to the dogfish family. The *bowfin,* a primitive, bony fish, is also occasionally called dogfish. But the bowfin is not a shark (see **Bowfin**). Samuel H. Gruber

Scientific classification. Dogfish belong to the family Squalidae. The spiny dogfish is *Squalus acanthias.*

Dogtooth violet, also called *trout lily* and *adder's tongue,* is the name of several spring wild flowers of the United States and Canada. Dogtooth violets are not really violets but belong to the lily family. Their bell-shaped flowers are yellow, white, or pink and have a faint fragrance. The *common dogtooth violet* is cultivated in many North American gardens. It is native to Europe and Asia.

WORLD BOOK illustration by Robert Hynes

The dogtooth violet is a dainty spring wild flower.

Dogtooth violets grow from a *corm* (thick, underground stem). Two smooth, grayish-green leaves, often with brown splotches, spring from the corm. The plants break through the ground in early spring and are often found on the banks of brooks. J. Massey

Scientific classification. Dogtooth violets are in the lily family, Liliaceae. The scientific name for the common dogtooth violet is *Erythronium dens-canis.*

Dogwood is the common name for a group of herbs, shrubs, and small trees. About 40 kinds are known. Fifteen of these are native to the United States and Canada.

The best known is the *flowering,* or *American, dogwood.* It has four large whitish *bracts* (modified leaves) beneath its small, greenish-white flowers. The bright-red *drupes* (fruits) usually have two seeds. The leaves have parallel veins that curve upward, and are quite rich in calcium. The polygonal pattern of the bark and the gray, urn-shaped flower buds make the dogwood an attractive winter tree.

Flowering dogwood rarely grows more than 40 feet (12 meters) tall or 18 inches (46 centimeters) in diameter. Its wood is hard and heavy. It is the state flower of North Carolina. It is also the state tree of Missouri and the state flower and tree of Virginia. The *Pacific dogwood* is the provincial flower of British Columbia. Jerry M. Baskin

© Jeffrey W. Myers, FPG

The flowering dogwood is a small North American tree that is covered with large flowers in the springtime.

Scientific classification. Dogwoods belong to the dogwood family, Cornaceae. Flowering dogwood is *Cornus florida.* Pacific dogwood is *Cornus muttallii.*

See also **Flower** (picture: Variations in flower structure); **Tree** (Familiar broadleaf and needleleaf trees [picture]).

Doha, *DOH huh,* also called Ad Dawhah (pop. 217,294), is the capital, largest city, and chief port of Qatar, a country on the Persian Gulf. Doha lies on the east coast of this Arab nation. For location, see **Qatar** (map).

Doha was a minor fishing port until the 1950's, when Qatar's rapidly developing oil wealth caused the city to change greatly. Doha became the commercial center of Qatar, and its population grew quickly. Many Arabs from nearby countries moved to Doha.

The city began a modernization program in the 1950's. This program included construction of an international airport and of a new harbor to serve oceangoing ships. Air-conditioned apartment and government buildings, hospitals, hotels, and schools replaced many of Doha's mud-walled houses. Robert Geran Landen

See also **Qatar** (picture).

Dolbear, *DOHL beer,* **Amos E.** (1837-1910), an American inventor and physicist, was one of several people who claimed to have invented the telephone before Alexander Graham Bell did. In 1878, two years after Bell received his patent, Dolbear sold the rights to his own work on the telephone to the Western Union Telegraph Company. In 1883, after a long court fight, Dolbear's claims were denied and Bell's were upheld.

Dolbear was born in Norwich, Connecticut. He taught physics at Tufts College (now Tufts University) from 1874 until his death. James E. Brittain

Doldrums. See **Calms, Regions of; Trade wind.**

Dole, Elizabeth Hanford (1936-), has had a long career in public service in the United States. Her posts have included the Cabinet positions of secretary of transportation and secretary of labor in the federal government, and the presidency of the American Red Cross. In 1975, she married Robert J. Dole. Her husband was

the 1996 Republican candidate for U.S. president. He lost to Democratic incumbent President Bill Clinton (see **Dole, Robert J.**).

Dole was born Elizabeth Hanford in Salisbury, North Carolina. She earned a B.A. degree from Duke University and an M.A. degree and a law degree from Harvard University.

American Red Cross

Elizabeth H. Dole

Dole held several important positions during Richard M. Nixon's presidency. From 1969 to 1971, she served as executive director of the President's Committee on Consumer Interests. She was deputy director of the Office of Consumer Affairs from 1971 to 1973. She served on the Federal Trade Commission from 1973 to 1979. From 1981 to 1983, Dole was President Ronald Reagan's assistant for public liaison. She served as Reagan's secretary of transportation from 1983 to 1987. She was secretary of labor under President George H. W. Bush in 1989 and 1990. From 1991 to 1999, Dole served as president of the American Red Cross. She was an unsuccessful candidate for the Republican nomination for president in the 2000 election. In 2001, Dole began campaigning to be elected a U.S. senator from North Carolina. Jackie Koszczuk

Dole, Robert Joseph (1923-), was the Republican nominee for president of the United States in 1996. He lost to his Democratic opponent, President Bill Clinton. A long-time congressional leader from Kansas, Dole had served more than 35 years in Congress.

Early life. Dole was born on July 22, 1923, in Russell, Kansas. His father owned a cream and eggs stand, buying cream and eggs from farmers and selling them in Russell. Later, he ran a grain elevator in the largely rural area. Robert—usually called Bob—was the second of four children.

Dole enrolled at the University of Kansas in September 1941. The United States entered World War II on Dec. 8, 1941, the day after the Japanese bombed American military facilities at Pearl Harbor. Dole enlisted in the Army in December 1942. He was sent to Europe in late 1944. In early 1945, he became a platoon leader in Italy, where U.S. forces were fighting Nazi Germans. Dole was severely wounded in April 1945. His right arm was permanently disabled.

Dole married Phyllis Holden in 1948. The couple had a daughter, Robin. The marriage ended in divorce in 1972. Dole received a bachelor's degree and a law degree from Washburn Municipal University (now Washburn University of Topeka) in 1952.

Political career. In 1950, while still in law school, Dole was elected to the Kansas House of Representatives. From 1952 to 1958, he won four terms as county attorney (chief prosecutor) of Russell County.

Dole was elected to the U.S. House of Representatives in 1960 and was reelected in 1962, 1964, and 1966. In 1968, he won his first of five six-year terms in the Senate. He became a strong defender of the policies of Republican President Richard M. Nixon and earned a reputation for his stinging criticisms of Democrats. Dole also served as chairman of the Republican National Committee from 1971 to 1973.

In 1975, Dole married Elizabeth Hanford of North Carolina. Like Dole, Hanford had a long career in government. For details, see **Dole, Elizabeth H.**

U.S. Senate

Robert J. Dole

Dole was the Republican nominee for vice president of the United States in 1976. President Gerald R. Ford and Dole were defeated by their Democratic opponents, former Georgia Governor Jimmy Carter and Senator Walter F. Mondale of Minnesota.

Dole was an unsuccessful candidate for the Republican presidential nomination in both 1980 and 1988. He served as majority leader of the Senate from 1985 to 1987 and as minority leader from 1987 to 1995. In January 1995, he became majority leader again.

In April 1995, Dole announced he would seek the 1996 Republican presidential nomination. By late March 1996, victories in primary elections had given him a sufficient number of committed delegates to win the nomination. In June, Dole resigned from the Senate to devote his time to the presidential campaign. In August, the Republican National Convention nominated Dole for president and Jack Kemp for vice president. The Democrats slated President Clinton and Vice President Al Gore. The federal government had run a large budget deficit for many years. The question of how to reduce the deficit became a major campaign issue. In the presidential election in November, Clinton and Gore defeated Dole and Kemp. Jackie Koszczuk

See also **Ford, Gerald R.**; **Kemp, Jack F.**

Dole, Sanford Ballard (1844-1926), led a group that helped make Hawaii a United States territory. In 1893, Dole took part in a movement that deposed Queen Liliuokalani. He then headed the provisional government.

Dole became president of the Republic of Hawaii in 1894 when President Grover Cleveland opposed annexation. The United States annexed Hawaii in 1898, after Cleveland left office. Dole served as the first territorial governor from 1900 to 1903 and as United States district judge in Hawaii from 1903 to 1916. Dole was born on April 23, 1844, in Honolulu. Pauline N. King

Dolin, *DOH lihn,* **Anton** (1904-1983), became the first world-famous British male dancer. He was partner to many great ballerinas, particularly Alicia Markova. Together they helped start British ballet. Dolin helped develop many companies, including what is now the Royal Ballet, the London Festival Ballet, and the American Ballet Theatre. He also led his own touring companies.

Dolin was born Sydney Francis Patrick Chippendall Healey-Kay in Sussex, England, on July 27, 1904. He became the only English-born male dancer to star with Sergei Diaghilev's Ballets Russes. Dolin enjoyed his greatest triumphs with Markova in his version of *Giselle* in the United States. Dolin's best-known work as a *choreographer* (creator of dances) is his ballet, *Le Pas de Quatre.* Queen Elizabeth II knighted him in 1981, and he became known as Sir Anton Dolin. Katy Matheson

WORLD BOOK photo by Dan Miller

The enchanting world of dolls is filled with lovable characters of every description. Some dolls represent babies, children, teen-agers, or brides. Others include costume dolls and cloth dolls.

Doll

Doll is a child's toy made to look like a human being. Dolls vary in size from $\frac{1}{2}$ inch (1.3 centimeters) tall to life-sized or even larger. They may be made of almost any material, including cloth, plastic, porcelain, wax, and wood.

Boys and girls throughout the world enjoy playing with dolls. But dolls also appeal to many adults because of the toys' artistry and historical representation. Many grown-ups collect antique and costume dolls as a hobby and learn about the people of other times and places through these dolls.

Dolls fulfill many needs of children. They serve as playmates and objects for children's affection. Dolls can also provide an outlet for a child's hurt feelings, anger, and other emotions. For example, youngsters upset by a scolding might scold their dolls in turn. How children play with dolls may thus reveal their inner needs, fears, and desires. For this reason, psychologists use dolls to help them identify and treat many problems of children. Playing with dolls enables children to rehearse the roles they hope to perform after they grow up, such as a parent or a doctor.

Doll-like figures have existed since ancient times. But dolls used mainly as toys for children probably were uncommon in most societies before the 1700's. Most doll-like figures from earlier periods were magical or religious objects, not toys. They were more like pieces of sculpture than toys. Ancient people made human figures as idols or *fetishes* (objects with magic power). Later, Christians made doll-like statues of saints and of figures for Christmas displays, called *crèches.* The figures in crèches showed the scene at Jesus' birth.

The toy dolls that existed before the 1700's served chiefly as playthings for adults as well as for children. At that time, adults and children were more alike in their attitudes and interests than they are today, and childhood as we know it did not really exist. Youngsters were regarded as little adults and were expected to act like them. They shared the work of supporting the family with their parents. People of nearly all ages enjoyed the same simple toys, including dolls and jack-in-the-boxes. Most of the dolls were shaped and dressed like adults.

Adults first came to regard childhood as a special time during the 1700's and especially the 1800's. The first dolls specifically for children probably were made in the 1700's. The dolls themselves looked the same but could be dressed as babies, children, women, or men. In the West, the first doll to be designed as a baby ap-

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Dorothy S. Coleman and Evelyn Jane Coleman, the contributors of this article, are doll collectors and, with Elizabeth Ann Coleman, authors of The Collector's Encyclopedia of Dolls *and* The Collector's Book of Dolls' Clothes. *Unless otherwise credited, the photographs in the article are courtesy of the Museum of the City of New York.*

peared at the London Exhibition of 1851 and came from Japan.

The word *doll* came into general use about 1750. It may have come from the Greek word *eidolon,* meaning *idol,* or from *Dolly,* a nickname for *Dorothy.* Previously, English-speaking people called dolls *puppets* or *babies,* even though most dolls represented adults.

Dolls around the world

Many manufactured dolls, including baby dolls, are the same throughout the world. But other dolls vary from country to country. These dolls include (1) costume dolls and (2) traditional dolls.

Costume dolls are dressed in the national or regional costumes of various countries. Many of the costumes worn by these dolls may represent holiday dress or work uniforms. Some costume dolls, however, wear clothing like that worn every day by many people of a particular country. For example, dolls from India wear a *sari*—a long piece of cloth draped around the body.

Most costume dolls are not toys. Instead, the dolls are made especially for the souvenir market. Dolls in local costume became a commercial item in the late 1800's, when travel became easier and the tourist trade suddenly began to develop. At first, most countries imported dolls from France and Germany, the leading doll-making nations of the time, and dressed the dolls in local costumes. In countries where most people had dark skin, fair-skinned imported dolls sometimes were tinted brown. Over the years, however, a number of countries began to make their own costume dolls.

Traditional dolls, or *folk dolls,* may also be dressed in regional costumes. But unlike most costume dolls, which are made in factories, folk dolls are made by local craftworkers using traditional handicraft skills. Most folk dolls are created from whatever materials are readily available in the area. For example, Eskimos make dolls from sealskin, and people in tropical regions weave dolls from palm leaves. Other materials used for folk dolls include clay, cloth, corncobs, deerskin, flowers, nuts, straw, and wood.

Few peoples or countries outside Europe had traditional dolls until they came into contact with European cultures. But over the years, many people developed their own traditional dolls. For example, the Sioux and other Indians of the Great Plains began to make dolls from deerskin decorated with glass beads and dyed porcupine quills. Indians still make dolls in this way.

African craftworkers make dolls of such native material as clay, feathers, and wood. Some dolls include discarded objects that the doll makers have found and reused. For example, some dolls have been made from various kinds of empty containers or even from old shoes.

Russian craftworkers use pine cones and twigs to form traditional dolls known as *moss men.* The dolls' name comes from their dried-moss cloaks. Another traditional Russian doll, the *matreshka,* is a set of four or more hollow wooden dolls that nest within one another. The Russians also made dolls out of triangular pieces of wood that were carved and painted.

Japan is one of the few countries in which children played with dolls before the country came into contact with Western customs. In fact, dolls were being made in Japan in the 1500's. Traditional dolls include round figures with rotating heads and figures of chubby baby boys. Doll making is an art in Japan, and skilled doll makers teach it at schools throughout the country.

Doll festivals and customs

The Japanese celebrate two yearly doll festivals, the Girls' Festival on March 3 and the Boys' Festival on May 5. During these celebrations, families display dolls that have been handed down for generations. Dolls for the Girls' Festival represent Japan's emperor and empress and members of their court. Dolls for the Boys' Festival include figures of heroes and warriors. Through the dolls, the children learn about their country's culture, history, and outstanding men and women.

Many people use doll-like figures in the practice of religion or magic, but such objects are not really playthings. For example, the Pueblo Indians of the Southwestern United States use figures called *kachina dolls* in their religion. The figures are carved from cactus root, cottonwood, and pine. Each is painted to represent one of the hundreds of *kachinas*—powerful spirits of the earth, sky, and water. To honor these spirits, the Indians hold ceremonies in which masked dancers seem to become the kachinas. After the ceremonies, Pueblo children are given the figures as educational toys to help them learn about the kachinas (see **Indian, American** [pictures: Kachina dolls]).

Many peoples practice a type of magic with dolls made in the likeness of their enemies. The *voodoo dolls* of the West Indies are a famous example. The magic involves sticking pins into the dolls or injuring them in

Margaret Woodbury Strong Museum, Rochester, N.Y.

Russian stacking dolls, painted to look like peasants, are hollow and fit inside one another. Woodcarvers make these dolls, called *matreshka,* in sets of 4, 6, 8, 10, 12, or more.

Margaret Woodbury Strong Museum, Rochester, N.Y.

Japanese festival dolls are displayed on shelves in homes during two yearly celebrations, the Girls' Festival on March 3 and the Boys' Festival on May 5. This pair of dolls, representing the emperor and empress of Japan, occupy the highest shelf during the Girls' Festival.

The Metropolitan Museum of Art, New York (Lisa Little)

A fertility doll is carried by Ashanti women of Ghana to bring them beautiful children.

other ways in the hope that these actions will bring harm to the enemy.

In some societies, women carry figures called *fertility dolls,* which they hope will help them bear children, especially beautiful children. Ashanti women of Ghana tuck such a doll into their waistbands. Mfengu women of South Africa carry a fertility doll until their first child is born. The women then give the doll to the baby and get a new doll to carry until their next child is born.

The history of dolls

Ancient times. The earliest known doll-like figures are wooden images found in Egyptian graves dating from about 2000 B.C. The figures are known as *paddle dolls* because they are carved from a flat piece of wood shaped like a paddle. They are painted with patterns to look like clothes and have strings of clay beads to represent hair or a headdress. The paddle dolls resemble dolls, but they were religious figures, not playthings. The Egyptians believed they could enjoy life after death in an *afterlife.* They buried these dolls with the dead to provide them with servants in the afterlife.

Doll-like figures have also been found in Greek and Roman tombs dating from the 300's and 200's B.C. They have jointed, movable arms and legs. Elegant ones are carved from bone or ivory, but most are made of wood or clay. Scholars do not know whether these figures were dolls or religious objects. But they do know that girls in ancient Greece played with dolls until shortly before marriage. They then left their dolls on the altar of Artemis, the goddess of childbirth, to show they had outgrown childish things.

The Middle Ages. Scholars know very little about the toys of the Middle Ages, a period of European history that lasted from about the A.D. 400's to the 1500's. Almost no dolls from this period have survived. But drawings from the period show two boys playing with miniature armored soldiers.

The oldest surviving doll-like figures made of cloth date from the 500's to 600's and come from Akhmim, Egypt. They were found in graves of Copts, members of a Middle Eastern Christian group. The dolls' facial features and costumes are woven into the fabric that forms their bodies.

The Bartholomew Fair, which first took place near London in the 1100's, became famous for its dolls. The fair continued to be held for about 800 years. The use of the word *doll* may have originated with the toymen at this fair.

The Renaissance was a period of great cultural and intellectual activity that spread throughout most of Europe from the 1300's to about 1600. During the Renaissance, the number of dolls increased. An interesting collection of toys from the mid-1400's was discovered in Nuremberg, Germany. The toys are made of fine white clay that had been pressed into molds and baked. The collection includes dolls that represent children in swaddling clothes, little men, and fashionable women of the time. Some of these dolls may have been intended as christening gifts.

In 1485, pictures of Nuremberg doll makers at work were published in the book *Hortus Sanitatis.* Dolls also appear in Renaissance paintings of children, painted mostly by English and French artists.

The 1600's and 1700's saw an increased demand for dolls, both as toys for children and as representations of the fashions at royal courts. Before 1770, there were no fashion magazines. Dolls dressed in the latest fashions were distributed around the world.

The peasants who lived in the wooded areas of Europe often made wooden dolls during the winter months. These dolls, usually sold at fairs, were dressed as children, women, or men. The wooden dolls of about 1700 usually had painted eyes. Later, larger dolls had glass eyes. Most of the dolls had wigs made of either human hair or flax. But painted hair was popular for

The Newark Museum, New Jersey

An ancient Greek doll, made about 400 B.C. of clay, is one of the oldest existing dolls.

English wooden dolls from the mid-1700's have dresses made of silk panels sewn together.

Papier-mâché dolls became popular during the early 1800's. These dolls, with molded hairstyles, were made in Germany from the 1820's to the 1840's.

smaller and less expensive wooden dolls. Cloth dolls were popular in this period, and many of them were probably made at home. Some were made of rolled cloth, and features were either embroidered or drawn on the face. Beeswax was another popular material for creating dolls.

Some dolls of the 1600's and 1700's were strictly adult amusements. In the 1700's, for example, French nobles played with dolls called *pantins.* A pantin was a jumping jack—a cardboard or wooden figure made to move by pulling a string attached to its arms and legs. At the end of the 1700's, dolls made of cardboard were mass-produced, especially in France.

The 1800's brought dramatic changes in adults' attitudes toward children, which greatly affected the history of dolls. Adults came to consider play important to children's development and so provided them with more dolls and other toys.

But in the first half of the 1800's, adults themselves found delight in *peddler dolls.* These dolls carried baskets with dozens of miniature items for sale, including buttons, brushes, kettles, and spools of thread. People usually bought the completed doll with its wares. The finished dolls were displayed under glass domes.

Toymakers of the 1800's created many new kinds of dolls using a variety of materials. According to collectors, the material of a doll is designated by the major material of the head. The majority of dolls can be grouped as: (1) wooden dolls, (2) cloth dolls, (3) papier-mâché and composition dolls, (4) wax dolls, (5) rubber dolls, and (6) porcelain dolls.

Wooden dolls from an area of Austria called the Grödner Tal (now part of Italy) were the most common commercial dolls in Europe and the United States during the early 1800's. Some English-speaking people called them *Dutch dolls,* a name that may have come from the German word *Deutsch,* which means *German.* The dolls may also have received their name from the fact that many were shipped from the Netherlands by Dutch merchants. Some collectors today call them *peg-wooden* dolls because wooden pegs hold the joints together.

The earliest pegwoodens were carefully made, with carved hairstyles and with joints that turned smoothly. Most people bought them without clothes and dressed them at home. The dolls gradually became poorer in quality. The last ones, made in the early 1900's, were splintery and easily broken.

Cloth dolls of the 1800's included soft cloth dolls and dolls with stiffened fabric heads. Beginning in 1831, books offered instructions on how to make cloth dolls at home. Later, magazines such as *Ladies Home Journal* and *Delineator* gave instructions for making dolls. Some of these dolls had needle-sculptured faces, and others had smooth faces. The commercial manufacturers of stiffened fabric cloth dolls in the 1800's were Izannah Walker, George Hawkins, and Martha Chase, all of the United States. Beginning in 1889, Celia and Charity Smith of the United States designed cloth dolls that could be printed on cloth, cut out, and sewed together at home.

Papier-mâché and composition dolls were made by mixing a variety of ingredients. Papier-mâché chiefly consists of paper or wood pulp mixed with glue and clay or flour. Composition is a mixture chiefly of resin, sawdust, starch, and water. These mixtures are easily molded while wet and become hard and strong when dry. With the use of molds, it became easy to produce large quantities of dolls.

German factories began to mass-produce papier-mâché head-and-shoulder units for dolls in the early 1800's. Some of these shoulder-heads were bought by people who attached homemade bodies to them. Most papier-mâché dolls were made in factories as complete dolls with wooden arms and legs and bodies of a thin leather called *kid.* These dolls lacked any joints. Most of

them represented females, and many had the fancy hairstyles of the time. Many were sold already dressed as children or adults. A few with simple molded hairstyles were dressed as men in top hats and knee-length, full-skirted frock coats. Papier-mâché dolls became highly popular, and German toymakers produced large quantities of them until the mid-1800's.

French toymakers produced a different type of papier-mâché doll during the 1800's. These French dolls appear cheap and flimsy, but they were actually rather expensive. Some were dressed as fine ladies, and others as clowns, babies in swaddling clothes, or military officers. Few of these fragile dolls have survived.

The first doll patented in the United States had a shoulder-head made of papier-mâché reinforced with cloth. Ludwig Greiner, a German-born toymaker in Philadelphia, patented it in 1858.

Composition dolls replaced papier-mâché dolls by about 1860. Most of the early composition dolls had a thin coating of wax to imitate the more expensive wax dolls.

Wax dolls are among the most fragile dolls. They break easily, and the wax melts or cracks in unsuitable weather. When the wax was reinforced with papier-mâché or composition, the dolls were more durable but not as artistic. Wax was used to cover almost every kind of material to make dolls and improve their appearance. Early in the 1800's, toymakers made waxed dolls' heads. Many of these heads had glass eyes and slits in which to insert hair. The eyes of some of these dolls could be opened and closed by pulling a wire. The early dolls had arms of colored kid representing long gloves. Later ones came with limbs of wood or composition. Some of these dolls had fancy hairdos of human hair or *mohair* (hair from the Angora goat). Others had hairdos and bonnets molded and waxed like the rest of the head.

Wax dolls of the 1800's were made in two ways. The German doll, *left,* was made of a substance called *composition* and dipped in wax. The British doll, *right,* was made of poured wax.

For hundreds of years, waxworkers had made religious figures by pouring liquid wax into a mold and allowing the wax to harden. Some of the finest wax dolls were made this way in England by two famous doll-making families, the Montanaris and the Pierottis. These expensive dolls had hair inserted strand by strand and faces modeled after real people. For the Great Exhibition of 1851 in London, Montanari made wax dolls that represented the children of the British monarch, Queen Victoria.

The first baby dolls also appeared at the 1851 exhibition. They were made in Japan. Many had a wax head or a head of other material dipped in wax. The head had a few painted wisps of hair. The cloth-covered body contained a squeak box. In 1852, *Harper's New Monthly Magazine* criticized these new baby dolls, saying that they resembled real babies too closely, especially in their crying.

Rubber dolls. In 1839, Charles Goodyear, a Connecticut inventor, developed a process that made rubber stronger and gave it resistance to heat and cold. This process was called *vulcanization.* Dolls made of rubber were most popular in the 1850's and 1860's. They represented both sexes and various ages. When a rubber doll was new, it was an ideal toy because it would not break and was soft to touch. When the doll was old, however, the rubber disintegrated. Very few exist. Because manufacturers used the same molds over long periods of time, experts find it hard to date a rubber doll unless it has its original clothing.

Porcelain dolls. In the 1840's, china factories in Germany and Scandinavia began to make doll heads in glazed porcelain. Most heads were of females with pretty faces, pale skin, and dark hair. Matching porcelain arms and legs were also made. But many of the cloth bodies were made at home. The manufacturers also made complete porcelain dolls, now called *Frozen Charlottes.*

About 1860, French doll makers began to produce costly dolls known today as *fashionable dolls* because of their elaborate clothes. The dolls were then called *poupées* (the French word for *dolls*). Most of them represented elegant young women or older girls and were made with great artistry. They had unglazed or glazed porcelain heads, and some had matching porcelain limbs. Most of them had firmly stuffed kid bodies. More costly dolls had jointed wooden bodies, which were painted or covered with kid. A French doll-making firm called Gesland used a jointed body covered with a padded, knit fabric "skin." Many dolls made by Maison Huret, another French firm, had bodies of a rubberlike substance called *gutta-percha.*

A fashionable doll that was dressed usually cost three times as much as the same doll wearing only its *chemise* (undergarment). European stores sold the clothes and accessories for these dolls. The accessories included combs, fans, furs, and jewelry. Many dolls had trunks or pieces of furniture to hold their belongings.

In Germany in the 1860's, unglazed porcelain became fashionable for dolls' heads. This material was also called *bisque* or *biscuit.* Most bisque shoulder-heads for dolls had elaborate molded braids, curls, and ring-

Bisque dolls, made of unglazed porcelain called *bisque,* became popular in the late 1800's. These French dolls date from 1865 to 1880. The dolls representing children are called *bébés.*

lets decorated with combs, flowers, insects, jewels, or ribbons. Unlike the dark-haired porcelain dolls, most bisque-head dolls with molded hair were blond. Often the same mold was used for both the glazed and unglazed versions of the doll. During the 1890's, a much cheaper doll was made from a coarse bisque called *stone bisque.* Some of these dolls, known as *bonnet dolls,* have hats molded onto their heads.

During the 1870's, French doll makers began to make dolls with the body and facial features of children about 4 years old. These dolls were called *bébés,* a French word meaning *babies.* Most bébés were named after their manufacturer. For example, Bébé Bru was made by a firm founded by Leon Casimir Bru. Bébé Jumeau was manufactured by a company headed by Emile Jumeau. Many bébés had a new kind of body consisting of a hollow trunk and balljointed limbs strung together with elastic. This construction allowed a doll to hold more natural, childlike poses.

Inventions. Many of the doll manufacturers developed mechanisms that allowed the dolls to behave in a lifelike manner. One of the earliest devices made it possible for a doll to say "mama" and "papa." German inventor Johann Mälzel patented the device in 1824. In 1862, several designers—including Americans Enoch Rice Morrison and Joseph Lyon—patented dolls that could walk. In 1878, Elie Martin of France patented a doll that could swim. In 1879, doll maker Casimir Bru of France patented *Bébé Teteur,* a doll that nursed, and *Bébé Gourmand,* a doll that consumed food. In the 1880's, American inventor Thomas Edison reduced the size of the record player he built so that it could fit inside the body of a doll and make it talk. Other patents included those for dolls with eyes that could wink and flirt.

Rivalry in the doll industry. Most porcelain dolls' heads for the French trade were made in Thuringia, Germany, until the late 1860's. At that time, François Gauthier (later spelled Gaultier), a French porcelain manufacturer, began to make bisque heads for dolls. In the mid-1870's, Frenchman Emile Jumeau, who also had a porcelain factory, created the famous Jumeau bébés. Gaultier and Jumeau made most of the bisque heads used on the French dolls in the late 1800's.

German manufacturers soon copied the Jumeau bébés. They were able to produce dolls that were less artistic but also less expensive. The Germans had learned how to pour *slip* (clay mixture) into the mold rather than press it into the mold as the French were doing. Pressing slip into the mold is a more expensive method. Soon the German manufacturers began to succeed at the expense of the French manufacturers. About 1890, Jumeau had to resort to using the cheaper pouring-slip method for making the heads of his bébés. By 1899, the various French doll makers combined for economic reasons into the Société Française de Fabrication de Bébés & Jouets. Salomon Fleischmann, a German living in France, controlled the group. Germans gained control of most of the doll business in France, England, and the United States.

The early 1900's produced a great variety of new dolls in many different materials. Bisque heads on composition bodies were the favorites. However, doll makers also used various types of composition heads. Composition dolls were often described as unbreakable. But composition cracked in time and was not as durable as bisque.

Before World War I. The emphasis in doll manufacturing during the early 1900's was on realism. Teachers and artists began to criticize the fashionable dolls as unnatural and unappealing to children. In Munich, Germany, a group of artists started a movement called *Puppen Reform* (doll reform). These artists designed all-composition dolls that were simple and natural. German doll makers Kämmer & Reinhardt and other firms manufactured dolls with bisque heads that were called *character dolls* because their faces showed realistic expressions.

Wooden dolls also reflected realism. In China, carved *Door of Hope* dolls had faces and clothes similar to what could be seen in that country. In 1911, Albert Schoenhut, a German-born toymaker of Philadelphia, patented his All-Wood Perfection Art Doll. The doll's joints had steel springs that enabled it to hold lifelike poses. Most Schoenhut dolls represented children or infants with realistic faces.

In 1909, an American illustrator named Rose O'Neill published a drawing of a character with large round eyes, a pug nose, and a curved-line mouth. O'Neill modeled the figure on her baby brother and called it *Kewpie,* a shortened form of the word *Cupid.* In 1913, doll manufacturers began producing Kewpie dolls. Kewpie dolls had small tufts of molded and painted hair, blue wings, and starfish-shaped hands. Millions of Kewpie dolls were made in bisque, Celluloid, composition, and other materials.

The comical kewpie doll came from a drawing by Rose O'Neill, an American illustrator. The dolls were first manufactured in Germany in 1913.

In the first decade of the 1900's, many U.S. businesses offered cloth dolls as advertising premiums. These dolls included Sunny Jim, a premium for Force cereal; Aunt Jemima, for Aunt Jemima pancake flour; and Buster Brown, for Buster Brown shoes.

When World War I broke out in 1914, European doll makers turned to other manufacturing activities, and the United States tried to fill the doll-manufacturing gap. One success appeared in 1915, when a New York City political cartoonist, Johnny Gruelle, obtained a design patent for a cloth doll named Raggedy Ann. Ann's twin brother, Raggedy Andy, appeared later. Both dolls became known by their red-and-white striped legs, red yarn hair, and shoe button eyes. Gruelle wrote a series of books about their adventures, beginning with *Raggedy Ann Stories* (1918). In general, however, U.S. manufacturers lacked skill and experience in producing dolls, and necessary materials were difficult to obtain. The doll-manufacturing gap existed until about 1920.

After the war, artists were especially successful with felt dolls, such as the Lenci dolls from Italy and the Chad Valley dolls made in England. Germany's economic problems in the early 1920's hindered the recovery of the German doll-making industry.

Dolls modeled on a newborn baby became popular in the 1920's. One of the most successful was the Bye-Lo Baby, first copyrighted in 1922 by an American sculptor named Grace Storey Putnam. Putnam used a newborn infant as a model, copying its half-closed eyes and fat neck. The first dolls had heads of wax. The dolls were later made of bisque, Celluloid, composition, rubber, vinyl, and wood. The Bye-Lo Baby became one of the most popular dolls ever and was known as the "million-dollar baby."

The Bye-Lo Baby was created in 1922 by the American sculptor Grace Storey Putnam. The Bye-Lo Baby on the left has a bisque head. The one on the right has a wax head.

Doll makers produced a number of other newborn baby dolls. The German firm of Armand Marseille made the bisque heads for many of these dolls. They included "My Dream Baby," produced by the U.S. firm of Arranbee; and "Rock-a-Bye Baby," made by the German firm of Cuno & Otto Dressel. Both of these dolls came in either a closed-mouth or open-mouth version.

The rise of motion pictures in the early 1900's led to the popularity of *portrait dolls.* These were dolls made to resemble well-known people or fictional characters. Among the most famous portrait dolls were those representing movie stars Charlie Chaplin, Jackie Coogan, and Shirley Temple.

Modern dolls. Plastic dolls appeared in the late 1940's, and plastic quickly became the most popular material for dolls. It first appeared in a hard form and then later as a soft material called vinyl. One of the earliest vinyl dolls was Sparkle Plenty, a doll with long blond hair and vinyl skin. The doll was based on a character in the "Dick Tracy" comic strip.

Beginning in the 1950's, children's TV programs inspired many other portrait dolls. They included Howdy Doody, Yogi Bear, and "Sesame Street" characters.

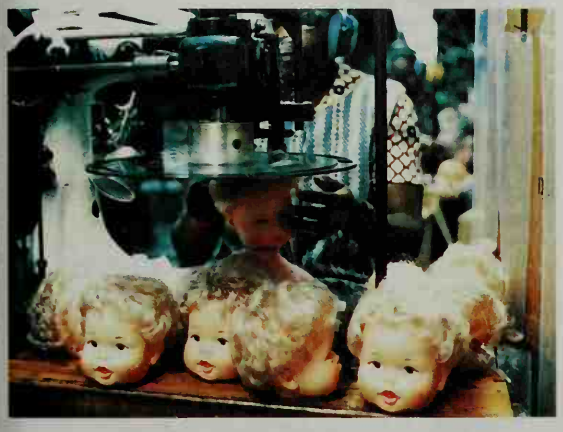
The most successful dolls of the 1950's were the teenage fashion dolls. The first one was Lilli, a German doll based on a comic strip and made in 1958. The American Barbie doll appeared in 1959. Like the fashionable dolls of almost 100 years earlier, these dolls have huge wardrobes. Unlike the fashionable dolls, they are play dolls rather than dolls made primarily to show fashions.

Also at this time, U.S. doll manufacturers began to use many technical devices to achieve a high degree of realism. They created dolls that changed expression, dolls with hair that appeared to grow, and dolls that played catch. A large number of dolls were mechanized, powered by batteries, operated by remote control, or run by a tiny computer inside the doll.

How dolls are made

Doll manufacturers make most dolls from plastic. Separate molds are made for the body, head, arms, and legs. Workers then add facial features and hair and assemble the parts.

Workers spray-paint the dolls' facial features.



A device like a sewing machine adds hair to the heads.

Ideal Toy Corporation (WORLD BOOK photos)

Assembly-line workers put the dolls together.

In the early 1960's, a soldier doll named G.I. Joe became the first doll designed specifically for boys to achieve worldwide popularity. Like Barbie, he has many clothes and accessories.

The 1970's brought renewed interest in the uncomplicated dolls of the past. As a result, manufacturers began to produce cloth dolls and other simple, homemade-looking dolls that encouraged make-believe.

In the 1980's, Cabbage Patch dolls became the most popular dolls among young children. Each doll has its own name and even a birth certificate. Its head is made of vinyl, porcelain, or an elastic cloth called *stockinet.*

Also in the 1980's, ethnic dolls became increasingly popular. For example, some Cabbage Patch dolls and Barbie dolls had dark skin. A number of companies manufactured collections of dark-skinned dolls created primarily for black children.

The doll industry today

The creation of a modern doll begins in a doll manufacturer's design department, where artists sketch ideas for new dolls. After company officials select a design, the design department builds a full-sized clay or wax model of the doll. Mold makers then form metal molds from the model. In most cases, they make separate molds for the body, head, arms, and legs.

Most doll parts are molded from vinyl or other plastics. The chief molding processes are blow molding and rotational molding. In *blow molding,* a machine squeezes hot, softened plastic into a mold. A blast of compressed air forces the plastic outward against the mold's cool walls, where it hardens. In *rotational molding,* a worker squirts powdered plastic resin into a mold. The mold is put in an oven and rotated so the plastic melts and covers the inside walls of the molds. The plastic hardens as it bakes.

After either molding process, the molds are opened and the doll parts removed. Skilled workers add facial features and hair to the heads. Finally, assembly-line workers attach the heads and limbs to the bodies, dress the dolls, and pack them. The dresses may be made in the same factory or purchased from specialists. The clothes have to be redesigned nearly every year to keep them up to date with fashion trends.

Doll manufacturers compete intensely. Most introduce several new dolls every year and take great care to keep their designs secret. Companies spend millions of dollars a year on advertising—especially on television—to create a market for their dolls.

Today, China, South Korea, and Taiwan are the leading producers of dolls. France, Germany and the United States are also major doll producers.

Doll collecting

Doll collecting is one of the most popular hobbies in the world. Collectors enjoy acquiring beautiful, artistic, rare, and unusual dolls. Depending on the kinds of dolls they collect, they may also learn about the history and customs of other countries through their hobby.

Antique dolls, particularly those more than 50 years old, usually are rare and costly. Many sell for $50 to $5,000 or more. Collectors buy and sell such dolls at auctions, antique shops, and shows, and through personal advertisements.

People who plan to collect dolls should study the subject of dolls before they buy any. They should read about the historical periods when dolls were produced and about the history of fashions and textiles. Above all, they should look at as many dolls as possible in museums, in private collections, and at shows.

What to buy. Collectors should try to buy antique dolls in the original clothing. It is always best if a collector can obtain a doll directly from its original owner. The owner is likely to have all the doll's original clothes and also can tell the collector the doll's *provenance* (history).

Some sellers re-dress dolls to make them look "pretty," but this practice may decrease a doll's value and destroy clues that reveal its history. Many types of dolls were made for a period of 40 years or more. But collectors often can arrive at a more precise date for a doll by examining the style and features of the doll's original clothing. Collectors must remember, though, that more than one generation of children might have played with a doll, and the doll's clothes may belong to several different periods.

Many collectors specialize in dolls of a specific country, manufacturer, material, period, or style. A specialized collection need not be costly. For example, you can find cloth dolls nearly everywhere. Or you might focus on costume dolls. You could even make an interesting collection of dime-store portrait dolls, which are sold briefly, then become rare and possibly valuable. Such dolls include the figures from the 1960's of U.S. President John F. Kennedy and of the Beatles, the noted British musical group. Dime-store dolls include the figures from the 1980's of British royal couple Prince Charles and Diana, Princess of Wales; and U.S. singer and songwriter Michael Jackson. These portrait dolls are called *collectible dolls.*

The rules of good collecting apply as much to dime-store dolls as to antique dolls. Collect and keep only dolls that are complete and perfect. Save all labels and tags on dolls and their original boxes. Store the dolls carefully to protect them from damage and dirt. When you display them, be sure they are not exposed to damaging elements, such as light, dust, or fumes. Keep up-to-date records of all your dolls.

Probably the most common mistake collectors make is to buy more dolls than they can afford or arrange in a pleasing display. A small collection of well-chosen and attractively displayed dolls is better than a large, unmanageable collection of poorly selected ones. Often, a collector can replace a poor example with a better example when one becomes available.

Many magazines focus entirely on dolls. These periodicals include the U.S. publications *The Doll Reader* and *Dolls; The Australian Doll Digest;* and magazines published in Germany and South Africa.

Dolls in museums

Many museums throughout the world have doll collections. Peddler dolls and other old dolls may be seen in London's Bethnal Green Museum, a branch of the Victoria and Albert Museum. The Musée Carnavalet and the Musée des Arts Decoratifs in Paris have rare dolls. Fine German collections are exhibited in the Germanic National Museum and the German Toy Museum in Nuremberg and the German Toy Museum in Sonneberg. Both cities are historic toymaking centers, and their museums have many dolls that probably were put away new many years ago.

The Strong Museum in Rochester, New York, which opened in 1982, includes the largest doll collection in a museum. The collection, which has about 25,000 dolls, was bequeathed by Margaret Woodbury Strong of Rochester.

Other excellent doll collections in the United States include those of the Museum of the City of New York; the Shelburne Museum in Shelburne, Vermont; the Wenham Museum, Wenham, Massachusetts; the Children's Museum, Indianapolis; and the Children's Museum, Boston. Many other U.S. museums have fine collections of dolls in storage that are brought out for special displays.

Dorothy S. Coleman and Evelyn Jane Coleman

Related articles in *World Book* include:

Dollhouse	Play	United States (The arts [picture])
Fetish	Puppet	
Kachina	Toy	

Outline

I. Dolls around the world
- A. Costume dolls
- B. Traditional dolls

II. Doll festivals and customs

III. The history of dolls

IV. The doll industry today

V. Doll collecting
- A. What to buy
- B. The rules of good collecting

VI. Dolls in museums

Questions

What countries are the leading producers of dolls?
Where can you find the largest doll collection displayed in a museum?
When did the first baby dolls appear?
What are some rules of good collecting for doll collectors?
What are *kachina dolls*?
What was the first doll specifically for boys to achieve worldwide popularity?
Where were the oldest known doll-like figures found?
What are some needs of children that dolls fulfill?
In what country do skilled doll makers teach people the art of doll making?
What doll became known as the "million-dollar baby"?

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Dollar is the monetary unit of the United States, Canada, and many other countries. The dollars of the United States and Canada are paper bills or coins equal to 100 cents. The U.S. dollar was modeled after a Spanish coin called the *peso* or *piece of eight.* The origin of the dollar sign ($) is unknown. It probably developed from *ps,* an abbreviation of the word *peso.* The use of the dollar

United States and Canadian dollar coins

WORLD BOOK photo by James Simek

The first U.S. silver dollar was minted in 1794. It had an eagle on the back and a liberty head on the front.

WORLD BOOK photo by James Simek

The Peace dollar was issued in the United States from 1921 to 1935. The word *Peace* appeared on the back of the coin.

WORLD BOOK photo by James Simek

The Anthony dollar, minted for circulation in 1979 and 1980, honored woman suffrage leader Susan B. Anthony.

Museum of the American Numismatic Association

The Dwight D. Eisenhower dollar, commemorating the 34th United States president, was minted from 1971 to 1978.

U.S. Mint

The Sacagawea dollar, first minted in 2000, honors the Shoshone woman who assisted the Lewis and Clark expedition.

WORLD BOOK photo

The Canadian dollar coin was first minted in 1989. A slightly different version was issued from 1987 to 1989.

sign has become as widespread as the use of the currency it represents.

The term dollar is derived from *Joachimsthaler,* a word originally applied to a large silver coin made from metal obtained from the Joachimsthal mine in Bohemia. Shortened to *thaler,* the name was later applied to many large silver coins of about the same size.

The United States dollar. By the 1760's, the American Colonies used pieces of eight for business. Few British coins were shipped to the colonies. But many pieces of eight circulated there as a result of illegal trade. By 1767, Maryland was issuing paper money in denominations that were expressed in dollars, and other colonies soon did the same. The American Continental Congress issued *Continental Currency* to finance the Revolutionary War in America (1775-1783) against the United Kingdom. These notes were promises of payment in dollars.

By an act of Congress in 1792, the dollar became the official currency unit of the United States. The values of all other United States coins were expressed in terms of the dollar's value. The earliest silver dollars appeared in 1794. Each weighed 27 grams (slightly less than 1 ounce). The amount of pure silver in the coins was just under 90 percent in early years, and exactly 90 percent after 1837. Silver dollars never became popular in the eastern United States, where people preferred using paper currency. However, the coins circulated widely elsewhere, especially in the Far Western States, the Pacific Northwest, and parts of the Southern States. The United States stopped its production of silver dollars for circulation in 1935.

In the late 1900's, there were attempts to revive the dollar coin. The Dwight D. Eisenhower dollar was minted from 1971 to 1978, and the Susan B. Anthony dollar was minted, for circulation, in 1979 and 1980. Both were made of a copper-nickel composition. Neither coin became popular. Paper dollars circulate widely in the United States, but dollar coins do not. A dollar coin commemorating the American Indian woman Sacagawea began circulating in early 2000.

The dollar in other countries. Canada adopted the dollar in the 1800's, indicating the importance of the U.S. dollar in trading. The Dominion of Canada issued its first paper dollars in 1870. Canada began to make silver dollars in 1935, the year the United States stopped minting the coin. In 1987, Canada introduced a new dollar coin to replace the paper dollar, which it stopped issuing June 30, 1989. The front of the coin had an image of Queen Elizabeth II of the United Kingdom as a young woman. In 1989, Canada began minting a revised version of the coin, which showed Elizabeth as an older woman.

Hong Kong has used the dollar since the 1860's. Australia adopted it in 1966 and New Zealand, in 1967. Many former British possessions in the Caribbean adopted the dollar in the late 1960's and early 1970's. R. G. Doty

See also Money (pictures); **Eurodollar; Half dollar.**

Dollar Decade. See **Roaring Twenties.**

Dollar diplomacy seeks to extend a nation's business interests in other countries through superior economic power instead of war. The term was first applied to United States policy in the Caribbean and other areas during President William Howard Taft's Administration. The period from 1909 to 1913 is generally considered the era of dollar diplomacy. See also **Taft, William H.** (Foreign affairs). Robert J. Pranger

Dollarfish. See **Butterfish.**

Dollhouse is a miniature house filled with tiny furniture and other home furnishings. Girls and boys like to play with dollhouses, and many adults enjoy building and furnishing them as a hobby. Old dollhouses also provide valuable information about life in the past.

The first dollhouses were made in the mid-1500's for

wealthy adults. Many stood 6 feet (1.8 meters) tall or taller. Many of these early houses were furnished like the homes of their owners, with fine furniture, pictures, china, and silver. Many Dutch merchants had *cabinet dollhouses,* which were wooden cabinets with tiny rooms instead of drawers or shelves. Famous cabinet dollhouses include the Utrecht Dollhouse, built about 1680, and a dollhouse built in the late 1600's for a Dutch woman named Petronella Brandt. In the early 1700's in Arnstadt, Germany, the Duchess Dorothea made a group of small furnished rooms she called *Mon Plaisir.*

Similar dollhouses became popular in Great Britain during the 1700's. Unlike the Dutch dollhouses, the British ones looked like real homes from the outside. They were called *baby houses* because of their size, and because dolls in these houses were called *babies.* The famous designer Thomas Chippendale possibly made furniture for one of these houses.

Children's dollhouses appeared in the late 1700's. They were smaller than adult dollhouses. Some were only 9 inches (23 centimeters) high. Fancy dollhouses continued to interest adults, however. The Stettheimer Dollhouse in the Museum of the City of New York was made in the 1920's by a society woman named Carrie Stettheimer. Well-known artists, including Marcel Duchamp, Gaston Lachaise, and William Zorach, created tiny works especially for this house. Another famous dollhouse was made in the 1930's for the silent-film star Colleen Moore. It is now in the Museum of Science and Industry in Chicago. The famous Queen's Dolls' House in Windsor Castle in England was made in the 1920's for Queen Mary.

A homemade dollhouse can be made from a wooden or cardboard box. Little rectangles of sandpaper can be used as bricks, and gift-wrap can serve as wallpaper. Furniture for the dollhouse can be made from many everyday materials. For example, a small handbag mirror might become a wall mirror for a dollhouse.

Dorothy Coleman and Evelyn Jane Coleman

Dolomite, *DAHL uh myt,* is a mineral that serves as the chief source of magnesium obtained from the earth's crust. It is fairly hard and brittle and consists of calcium carbonate and magnesium carbonate. Dolomite's chemical formula is $CaMg(CO_3)_2$. Pure dolomite may appear white or yellow. Impurities, such as manganese or iron, may make dolomite pink, brown, or some other color. Dolomite and a mineral called *calcite,* which consists only of calcium carbonate, often look alike.

The term *dolomite* also refers to rock composed principally of dolomite. This rock also is called *dolostone* or *dolomite rock.* Dolostone may form when magnesium carbonate replaces part or all of the calcium carbonate in limestone or the skeletal remains of marine organisms. The rock also may form from minerals that settle out of seawater, or from hardened deposits of mud and mineral matter. Many mountain ranges in Europe and other parts of the world have great masses of dolomite rock. The rock also occurs in various parts of North America.

Iron and steel manufacturers use dolomite in the smelting process. Finely ground dolomite is used as a filler in paint, putty, and rubber. Marble composed of dolomite crystals is famous for its unusual colors and is used as a building material. David F. Hess

See also **Marble.**

Dolphin, *DAHL fuhn,* is the name of a group of sea animals closely related to whales and porpoises. Like whales and porpoises, dolphins are mammals, not fish. Mammals, unlike fish, feed their young with milk that is produced in the mother's body. Also unlike fish, dolphins have lungs and are *warm-blooded*—that is, their body temperature always stays about the same, regard-

Museum of the City of New York (WORLD BOOK photo)

A furnished dollhouse includes beds, chairs, tables, lamps, and such household articles as books, clothes, dishes, and pictures. This complete six-room dollhouse dates from 1895.

less of the temperature of their surroundings. Many scientists believe that dolphins rank among the most intelligent animals, along with chimpanzees and dogs.

Dolphins, porpoises, and whales are members of a group of mammals known as *cetaceans* (pronounced *suh TAY shuhnz*). Scientists classify dolphins, porpoises, and certain whales as a group of cetaceans called *toothed whales*. Dolphins and porpoises are very similar in appearance. Their chief differences occur in the snout and teeth. Dolphins have a beaklike snout and cone-shaped teeth. Porpoises have a rounded snout and flat or spade-shaped teeth. Whales are much larger than most dolphins and porpoises.

Scientists apply the term *dolphin* to two families of cetaceans, *marine dolphins* and *river dolphins*. There are 32 species of marine dolphins. They are found in nearly all oceans, and most of them live only in salt water. Many species of marine dolphins remain near land for most of their lives, but some live in the open sea. River dolphins live in fresh or slightly salty water. This article focuses on marine dolphins. For information about river dolphins, see **River dolphin**.

Types of dolphins

The various species of dolphins usually range from 4 to 30 feet (1.2 to 9 meters) long and weigh from 100 pounds (45 kilograms) to 10 short tons (9 metric tons). The most familiar types are the *bottle-nosed dolphin* and the *common dolphin*.

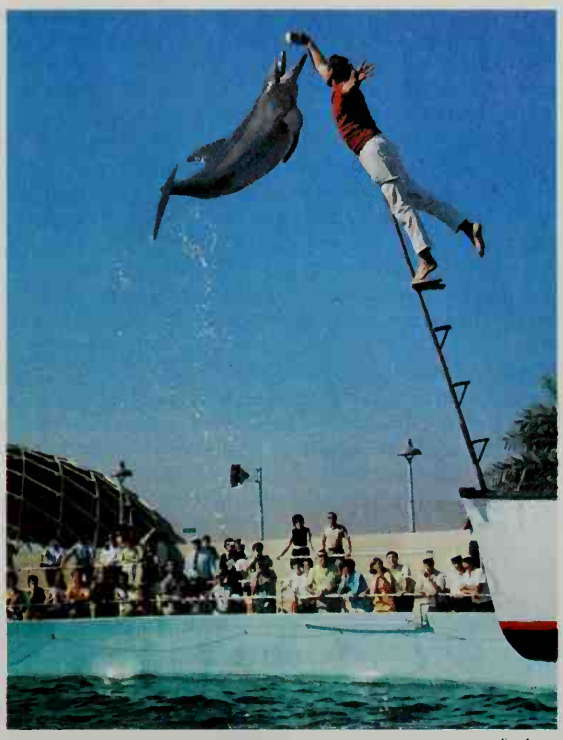
The bottle-nosed dolphin is the best-known species. Its short beak gives this dolphin an expression that looks like a smile. Most performing dolphins in aquariums and zoos are bottle-nosed dolphins. Members of this species measure up to 13 feet (4 meters) long and can weigh as much as 600 pounds (272 kilograms). They are gray, but their backs are darker than their undersides. Bottle-nosed dolphins show apparent great friendliness toward people, and they often swim alongside ships. They also adapt well to life in captivity.

Bottle-nosed dolphins live in temperate to tropical waters. Most of them stay within 100 miles (160 kilometers) of land. Many live in bays and protected inlets, where the water is relatively shallow. Bottle-nosed dolphins are found the year around off the coast of Florida. They range as far north as Japan and Norway and as far south as Argentina, New Zealand, and South Africa.

The common dolphin has several distinct features. For example, a dark band around the eyes extends to the end of the long, narrow beak. Common dolphins also have black backs, white undersides, and prominent gray and yellowish-brown stripes on their sides. These dolphins grow from 6 to 8 feet (1.8 to 2.4 meters) long and weigh up to 165 pounds (75 kilograms).

Common dolphins live in temperate to tropical waters. They often swim in large schools and are frequently seen in the open ocean. Common dolphins may follow ships for long distances, playfully leaping out of the water and turning somersaults.

Other species include *killer whales*, the largest dolphins. Killer whales can reach a length of 30 feet (9 meters) or longer and may weigh up to 10 short tons (9 metric tons). Members of another species, the *pilot whales* or *blackfish*, grow 15 to 20 feet (4.6 to 6 meters) long. Pilot whales have gray to black backs and sides.



Jim Annan

A trained dolphin, *above*, leaps high out of the water to snatch an object from a trainer's hand. Many dolphins are trained to perform in shows at aquariums and zoos.

These dolphins differ from other large dolphins in that they have bulging foreheads. Among the most common species of dolphins are *spinner dolphins*, which may spin on their sides when they leap out of the water.

Many kinds of dolphins have distinguishing colors or other markings. For example, *Risso's dolphins* are brown and gray, and most of them have many irregular white streaks. *White-sided dolphins* have gray, white, and yellow stripes on their sides. *Spotted dolphins* are named for their white spots. *Striped dolphins* have black stripes on their sides.

The bodies of dolphins

All dolphins have torpedo-shaped bodies, enabling them to move through water quickly and easily. They have a pair of paddle-shaped forelimbs called *flippers*, but no hindlimbs. Most species of dolphins also have a *dorsal fin* on their back. This fin, along with the flippers, helps balance the animal when it swims. Powerful tail fins, called *flukes*, propel dolphins through the water.

The skin of dolphins is smooth and rubbery. A layer of fat, called *blubber*, lies beneath the skin. The blubber keeps dolphins warm and acts as a storage place for food. It is lighter than water, and so it probably also helps dolphins stay afloat.

Like all other mammals, dolphins have lungs. The animals must surface regularly to breathe air and usually do so once or twice a minute. A dolphin breathes through a *blowhole*, a nostril on top of its head. The animal seals its blowhole by means of powerful muscles most of the time while underwater.

Dolphins have a highly developed sense of hearing. They can hear a wide range of low- and high-pitched sounds, including many that are beyond human hearing. Dolphins also have good vision, and the entire surface of their bodies has a keen sense of touch. All these senses function well both above and below the surface of the water. Dolphins have no sense of smell.

Dolphins have a natural sonar system called *echolocation,* which helps them locate underwater objects in their path. A dolphin locates such objects by making a series of clicking sounds. These sounds leave the animal's body through the *melon,* an organ on top of the head. The melon consists of special fatty tissue that directs the sounds forward. Echoes are produced when the sounds reflect from an object in front of the dolphin. By listening to the echoes, the animal determines the location of the object.

Most kinds of dolphins have a large number of teeth. Some species have more than 200. Dolphins use their teeth only to grasp their prey, which are chiefly fish and octopuslike animals called *squids.* Dolphins swallow their food whole and usually eat the prey headfirst.

The life of dolphins

Most dolphins mate in spring and early summer. The males are called *bulls,* and the females are called *cows.* The courtship behavior may involve head-bumping. The pregnancy period for most species of dolphins lasts from 10 to 12 months. The females almost always give birth to one baby, called a *calf,* at a time. After the calf is born, it immediately swims to the surface for its first breath of air. A newborn dolphin is about a third as long as its mother.

Female dolphins, like all female mammals, have special glands that produce milk. The calf sucks the milk from its mother's nipples. The females nurse and protect their young for more than a year. Male dolphins take no part in caring for the young.

Most species of dolphins live at least to 25 years of age. Some pilot whales reach 50 years of age. Sharks are

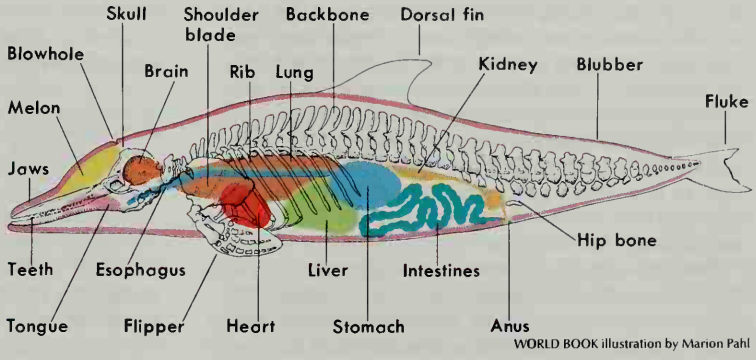
Some kinds of dolphins

WORLD BOOK illustrations by James Teason

Tom Stack

Many sharp teeth line the dolphin's jaws. A fatty organ called the *melon* causes a bulge on top of the animal's head.

The body of a common dolphin



WORLD BOOK illustration by Marion Pahl

the chief natural enemies of dolphins.

Some dolphins die after swimming into extremely shallow water and stranding themselves on the shore. The animals cannot live long out of water because their bodies become overheated. Scientists do not know why dolphins beach themselves. Most beached dolphins die from natural causes.

Group life. Most knowledge about the living habits of dolphins comes from aquariums and zoos. Killer whales seem to have the closest-knit groups, most of which consist of from several to 17 or 18 animals. Bottlenosed dolphins live in groups of about 12. Among some species the groups combine and form herds of 100 to 1,000 dolphins.

Adult males and young dolphins move among groups of females with their calves. The animals in such groups play and hunt for food together. They also help other members of the group that are in trouble. Dolphins sometimes use their backs or flippers to keep an ill or injured dolphin near the surface.

Dolphins communicate with one another in a variety of ways. For example, they may use a complex series of whistles and clicks called *phonations*. The animals make these sounds in air-filled sacs connected to their blowholes. Dolphins also communicate by slapping their flukes on the surface of the water.

Swimming and diving. Dolphins swim by moving their flukes up and down. This action differs from that of most fish, which propel themselves through the water by swinging their tail fins from side to side. Dolphins use their flippers to make sharp turns and sudden stops. Killer whales and some smaller species of dolphins can swim at speeds of 20 to 25 miles (32 to 40 kilometers) per hour. But they can maintain those speeds for only a short time. Most dolphins swim much slower.

Dolphins do not usually dive deeply, though they have the ability to do so. Some dolphins have been trained to dive more than 1,000 feet (300 meters). When a dolphin dives, its lungs collapse and its heart rate slows down. These actions allow the animal's body to adjust to the increasing pressure as the dolphin dives deeper underwater.

Dolphins and people

The attraction between dolphins and people goes back thousands of years. Ancient Greek artists decorated coins, pottery, and walls with pictures of dolphins, and the animals appear in Greek and Roman mythology. The ancient Greeks considered the common dolphin sacred to the god Apollo. For centuries, sailors have regarded the presence of dolphins near ships as a sign of a smooth voyage.

On the other hand, hunters of several nations, including Sri Lanka and Japan, kill thousands of dolphins annually. The dolphins provide meat eaten by people and animals, and the oil from their bodies is used as a lubricant. In addition, millions of dolphins have drowned in fishing nets that were intended to catch cod, mackerel, salmon, and other kinds of fishes. Tuna fishing crews have been responsible for the largest number of these

Lewis Wayne Walker

Dolphins often travel in large groups called *herds*. A dolphin swims by moving its tail and the rear part of its body up and down. The animal's streamlined shape and smooth skin reduce friction with the water.

deaths among dolphins. For some unknown reason, some species of dolphins often swim over large schools of yellowfin tuna. As a result, nets meant to catch tuna trap many dolphins as well. In 1972, the United States government passed a law limiting the number of dolphins that could be killed yearly by tuna fishing crews. Improved fishing technology also greatly reduced the number of dolphins killed unintentionally by human beings. In 1990, leading U.S. tuna-canning companies announced that they would refuse to accept tuna caught in nets that also kill dolphins.

Since the mid-1900's, hundreds of dolphins have been trained to perform in shows presented by aquariums, zoos, and amusement parks. Scientists conduct various types of research on dolphins to understand their complex communication systems.

Training dolphins. Most trained dolphins in amusement parks, aquariums, and zoos are bottle-nosed dolphins, though many pilot whales, spotted dolphins, and killer whales also perform in shows. These playful animals sometimes invent new behavior patterns by watching other dolphins perform. Trained dolphins jump through hoops, throw balls through nets, or "walk" backward on the water by using their powerful flukes. Some leap 15 to 20 feet (4.6 to 6 meters) out of the water to ring a bell or to take a fish from a trainer's mouth.

Research on dolphins has mostly concentrated on dolphins' echolocation and communication systems. For example, dolphins that have been blindfolded with suction cups use echolocation to detect even small differences in the shape, size, and thickness of objects. Scientists have also studied the diving ability of dolphins.

Certain sounds that dolphins make when communicating with one another apparently are associated with specific situations. For example, some zoologists believe dolphins make a particular sound when they are in trouble, though these distress calls vary. Eventually, researchers hope to learn the exact nature of the information that dolphins apparently transmit among themselves. Daniel K. Odell

Scientific classification. Marine dolphins make up the family Delphinidae in the order Cetacea. The bottle-nosed dolphin is *Tursiops truncatus*. The common dolphin is *Delphinus delphis*.

Wometco Miami Seaquarium

Baby dolphins are born in the water. The infant immediately swims to the surface for its first breath of air. The mother nurses its baby with milk for about a year. Dolphins breathe through a *blowhole* on top of the head.

See also **Killer whale; Pilot whale; Porpoise; River dolphin; Whale.**

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Dolphin, *DAHL fuhn,* is a large game fish that lives in warm salt waters. It is also called *dorado* or *mahi mahi.* The largest dolphins are about 6 feet (1.8 meters) long and weigh 75 to 100 pounds (34 to 45 kilograms). They live in all tropical oceans. The dolphin's long body tapers toward a V-shaped tail. It is shimmery bluish-green and silver. A fast swimmer, the dolphin sometimes chases flyingfish at sea for food. The dolphin is good to eat. William N. Eschmeyer

Scientific classification. The dolphin is in the family Coryphaenidae. The most common species is *Coryphaena hippurus.*

See also **Fish** (picture: Fish of coastal waters).

Domagk, *DOH mahk,* Gerhard, *GEHR hahrt* (1895-1964), a German physician, identified the therapeutic ability of the chemical *prontosil rubrum,* the first of the sulfa drugs. He showed that this drug—commonly known by the trade name Prontosil—effectively destroyed streptococcic bacteria. These bacteria cause a wide variety of infections, including strep throat, scarlet fever, and impetigo. Domagk won the 1939 Nobel Prize in physiology or medicine for his discovery.

Domagk's later publications dealt chiefly with the search for a cancer cure. He was born on Oct. 30, 1895, in Lagow, Germany. Daniel J. Kevles

See also **Sulfa drug** (Development of sulfa drugs).

Dome. For illustrations of domes, see **Architecture; India** (The Taj Mahal); **Milwaukee** (The Mitchell Park Conservatory); **New Orleans** (The Louisiana Superdome); **Washington, D.C.** (The United States Capitol). See also **Fuller, Buckminster; Hagia Sophia; Pantheon; Taj Mahal.**

Domesday Book, *DOOMZ day* or *DOHMZ day,* was the first official record of the property holders living in England and the amount of land they held. The information was collected and recorded at the command of William the Conqueror in 1086, 20 years after he and his followers from Normandy crossed the English Channel and conquered England. Afterward, the properties of the great English landholders were taken over by William and his followers. William ordered the Domesday survey to discover how much land he owned, how the rest was divided, and how the land was peopled.

The kingdom was divided into districts. Each district supplied census takers who knew the territory. The census and the land survey covered most of the territory William controlled. No survey was held in either London or Winchester, and information about regions in northern England is incomplete. Nevertheless, Domesday Book is viewed as the greatest public record of medieval Europe. It is displayed at the Public Record Office in London. C. Warren Hollister

See also **Norman Conquest.**

Domestic violence refers to physical, sexual, emotional, or psychological abuse between marital partners, former partners, and other adults who are, or have been, in close relationships. Most experts distinguish domestic violence from the mistreatment of the elderly or of children (see **Child abuse**). Both men and women may act violently toward each other. But women are more likely than men to be injured or murdered by their partners.

Domestic violence leaves long-lasting effects on its victims and their families. Victims may abuse alcohol or drugs and experience depression, eating disorders, or other types of psychological distress. They are also more likely than nonvictims to consider or attempt suicide. Children who witness domestic violence often experience emotional and psychological distress. They are more likely than other children to become violent.

For many years, most social scientists, law professionals, and other experts considered domestic violence a "private matter." Today most experts recognize it as a dangerous social problem. A variety of services help prevent and treat domestic violence, including shelters for battered women. Shelters provide a wide range of programs, including legal assistance and counseling for victims and their children.

Since the 1980's, all 50 states of the United States have enacted laws that specify domestic violence and violence against women as crimes. Laws have made it easier for women to obtain *restraining orders,* court orders designed to prohibit offenders from contacting their victims. Many states also require police officers to arrest offenders in cases of domestic violence. The federal government passed the Violence Against Women Act in 1994. It grants money to state and local governments to establish programs and shelters for battered women. The act also identifies *stalking* (repeatedly threatening, following, and harassing a victim) as a crime.

There is no single reason for domestic violence. Many offenders have a history of alcohol or drug abuse. Some experience stress caused by unemployment, sexual difficulties, and low job satisfaction. The most abusive offenders tend to have severe emotional problems. Numerous offenders were abused as children.

Many programs are available to treat people who commit domestic violence. Judges often require men who assault their wives to attend these programs as a condition of their sentence. Richard J. Gelles

Dominance is a form of behavior among individual animals that shows their ability to win aggressive encounters with other animals. These animals may be members of the same species or of different species. Dominance determines which individuals have first choice of resources that are needed to survive and reproduce and that are in limited supply. These resources include food, water, a resting place, or mates. Animals that lose the aggressive encounters or give in to dominant individuals without a fight are called *subordinates.* Subordinates that are denied use of scarce resources may be among the first to die or to leave an area.

In a group, a particular individual may be dominant to some members and subordinate to others. This results in a *dominance hierarchy*—that is, a ranking of individuals by their dominance in relation to each other. In many cases, an individual is subordinate to all those ranked above it and dominant to those below it. This type of ranking is called *linear dominance hierarchy.* However, dominance hierarchies may be more complicated. For example, in *circular dominance hierarchy,* individual A may be dominant to individual B and B dominant to individual C, but C is dominant to A. Individuals can improve their position in the group's dominance hierarchy as they gain experience or maturity, or as their reproductive condition changes.

Encounters that establish dominance only occasionally include actual fighting. In most cases, these encounters involve only signals that indicate an individual's willingness or ability to win a potential fight. An individual's large size or threatening natural weapons, such as the horns of mountain sheep or the powerful jaws of a wolf, might cause subordinates to give up without a fight.

Dominance differs from *territoriality,* a form of animal behavior in which an individual or group claims a certain area as its own (see **Territoriality**). A dominant individual usually can win wherever it is. Larry L. Wolf

Domingo, *doh MIHNG goh,* **Placido,** *PLAH see doh* (1941-), a Spanish tenor, became one of the most popular opera singers of the 1900's. Domingo gained international praise for his performances in lyric and heroic roles in Italian operas. He has also sung a number of major roles in the German operas of Richard Wagner.

Domingo was born in Madrid. He moved with his family to Mexico in 1950 and studied singing at the National Conservatory of Music in Mexico City.

Domingo made his opera debut in 1960 in Monterrey, Mexico, as Alfredo in *La Traviata.* Domingo sang with the Israeli National Opera from 1962 to 1965 before becoming a leading tenor with the New York City Opera from 1966 to 1968. He made his debut with the Metropolitan Opera in 1968 as Maurizio in *Adriana Lecouvreur.* During the 1990's, Domingo and tenors Luciano Pavarotti and Jose Carreras gave a number of enormously popular concerts called "The Three Tenors" throughout the world. Domingo became artistic director of the Washington (D.C.) Opera in 1996 and in 2000 also assumed the same post at the Los Angeles Opera. Thomas Bauman

Dominic, Saint (1170?-1221), was a Spanish religious leader. Dominic founded the Order of Friars Preachers, also called the Dominican Order. He was born in Calaruega in the Old Castile region of Spain. He studied at

WORLD BOOK photo

Dominance affects how wolves behave with one another. Low-ranking wolves retreat at threats from the pack leader, *far left.*

the University of Palencia and became a canon at the cathedral of Osma, near El Burgo. Later, he opposed the heretical teachings of the Albigenses. In 1216, Pope Honorius III gave him permission to establish a new religious order for the purpose of preaching against heresy. By the time of Dominic's death, the order had spread throughout Europe. Saint Dominic's feast day is celebrated on August 4. William J. Courtenay

See also **Albigenses; Dominicans.**

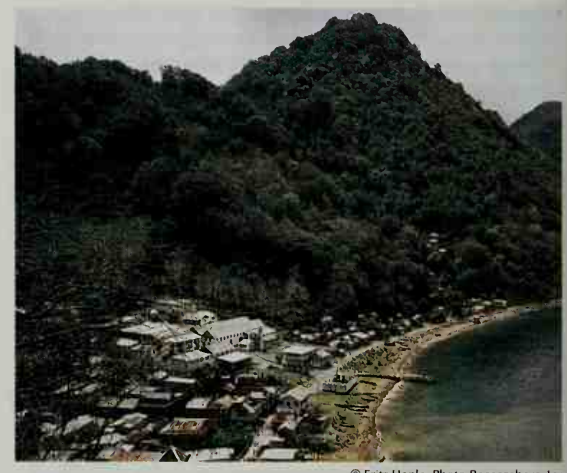
Dominica, *DAHM uh NEE kuh* or *duh MIHN uh kuh,* is a small island country in the Caribbean Sea. It consists of one island that lies 320 miles (515 kilometers) north of the Venezuelan coast (see **West Indies** [map]). Dominica has an area of 290 square miles (751 square kilometers) and a population of about 71,000.

Dominica became independent in 1978 after being ruled by Britain since the 1700's. Its official name is Commonwealth of Dominica. Roseau, which has a population of about 11,000, is the capital and largest city. Dominica's basic unit of money is the East Caribbean dollar. For a picture of the Dominican flag, see **Flag** (Flags of the Americas).

Government. Dominica is a republic. A president is officially the country's chief executive. But a prime minister is the most powerful official. The prime minister is a member of an eight-member Cabinet, which conducts the operations of the government. A legislature called the House of Assembly makes the nation's laws. It consists of 21 members elected by the people and 3 appointed by the government. The legislature elects the president. The prime minister is the leader of the political party with the most seats in the legislature.

People. Most Dominicans have African or mixed African, British, and French ancestry. A small percentage of Dominicans have mostly Carib Indian ancestry. About four-fifths of the people live in rural villages, and the rest live in urban areas. Most of the people of Dominica live in Western-style houses or in thatch-roofed huts. They wear Western-style clothing. Their main foods include bananas, crabs, crayfish, frog legs, lobsters, and sweet potatoes.

The majority of Dominicans who live in cities speak English, the nation's official language. The villagers chiefly speak a *patois* (dialect) that is a mixture of African languages and French. About 80 percent of the people are Roman Catholics, and almost all the rest are Protestants. Dominica has about 55 elementary schools and 7 high schools.



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Dominica is a small island country in the Caribbean Sea. The village of Soufrière, *above,* lies on the country's southern coast.

Land and climate. Dominica is a mountainous, tree-covered island formed by volcanic eruptions. Some mountains in the north and south rise over 4,000 feet (1,200 meters). Flatland lies on parts of the coast. The country has many rivers, but most are too rough to be used by boats other than canoes. Temperatures in Dominica seldom rise above 90 °F (32 °C) or fall below 65 °F (18 °C). Annual rainfall ranges from 79 inches (201 centimeters) in Roseau, on the southwest coast, to 400 inches (1,000 centimeters) in the mountains.

Economy of Dominica is based on agriculture. More than 60 percent of the people work on farms, and most of the rest are employed in processing agricultural products. Bananas are the country's chief product and export. Other products and exports include coconuts and coconut by-products. Manufacturing, mining, retail trade, and tourism are minor economic activities.

History. Arawak Indians, Dominica's first inhabitants, settled there about 2,000 years ago. Carib Indians took over the island about 1,000 years later. On Nov. 3, 1493—a Sunday—Christopher Columbus became the first European to sight the island. He named it *Dominica,* the Latin word for *Sunday.*

French and British settlers began to arrive in Dominica in the 1600's. For many years, the Carib, British, and French fought for control of the island. The British gained possession of it in 1763 and shipped African slaves to Dominica as farmworkers. The slaves were freed in 1834, the year after Britain abolished slavery throughout its empire. From the 1930's to the 1970's, Britain increased Dominica's control over its own affairs. Dominica became independent on Nov. 3, 1978.

In 1979, a major hurricane struck Dominica. It killed over 50 people and caused much damage. In 1983, Dominica and several other Caribbean nations joined the United States in an invasion of Grenada, another West Indian country, to overthrow a Marxist government there. See **Grenada** (History and government).

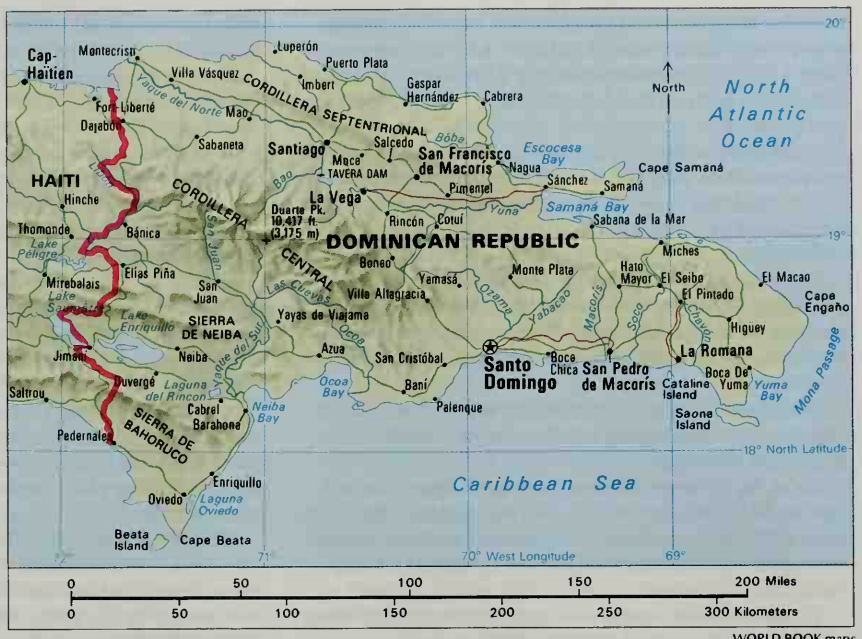
Gustavo A. Antonini

See also **Roseau.**

Dominica

WORLD BOOK maps

Dominican Republic



WORLD BOOK maps

Dominican Republic is the country that makes up the eastern two-thirds of the island of Hispaniola. Haiti covers the island's western end. The Dominican Republic is in the West Indies island group, about 575 miles (925 kilometers) southeast of Miami, Florida. The country is a land of fertile valleys and forested mountains.

Santo Domingo, a busy port city, is the capital and largest city of the Dominican Republic. The country's name in Spanish, the official language, is República Dominicana.

Christopher Columbus landed on Hispaniola in 1492. Some historians believe he is buried on that island in the Cathedral of Santo Domingo. Santo Domingo was the first city in the Western Hemisphere founded by Europeans. The University of Santo Domingo, which was established in 1538, is the oldest university in the Western Hemisphere.

During much of its history, the Dominican Republic has been ruled by dictators and by other countries. United States troops occupied the country twice in the 1900's to halt fighting between political groups there.

Government. A president heads the Dominican Republic. The president appoints a Cabinet. The national legislature consists of a 27-member Senate and a 120-member Chamber of Deputies. The people elect the president and legislators to four-year terms. Only civilians over 18 can vote.

The Dominican Republic is divided into 26 provinces and one national district—the capital and its surrounding area. The president appoints provincial governors and *commune* (county) leaders. The people elect the leaders of the country's 100 *municipios* (townships).

People. Most Dominicans speak Spanish and follow other ways of life brought to their land from Spain. The early Spanish colonists nearly wiped out the Indians who lived on the island before the Spaniards arrived. African influence, which came to the country chiefly by way of Haiti, is strong. In Haiti, most of the people are descendants of slaves from Africa.

About 75 percent of the people are of mixed black and white descent. About 10 percent are black, and about 15 percent white. Some descendants of ex-slaves from the United States live near Samaná Bay in the northeast. A small group of European Jews settled near Puerto Plata in the north about 1940.

Most Dominicans who live in rural areas work on farms. Some own small farms and raise their own food. They sell some of what they raise to buy clothes, household goods, and other items. Other Dominican farmers

Facts in brief

Capital: Santo Domingo.
Official language: Spanish.
Form of government: Republic. *Head of state*—president.
Area: 18,816 mi² (48,734 km²). *Greatest distances*—east-west, 240 mi (388 km); north-south, 170 mi (274 km). *Coastline*—604 mi (972 km).
Elevation: *Highest*—Duarte Peak, 10,417 ft (3,175 m) above sea level. *Lowest*—Lake Enriquillo, 150 ft (46 m) below sea level.
Population: *Estimated 2002 population*—8,740,000; density, 464 per mi² (179 per km²); distribution, 62 percent urban, 38 percent rural. *1993 census*—7,293,390.
Chief products: *Agriculture*—avocados, bananas, cacao, coffee, mangoes, rice, sugar cane, tobacco. *Mining*—gold, nickel. *Manufacturing*—molasses, sugar.
National anthem: "Himno Nacional."
Flag: A white cross divides the *national flag,* flown by the people, into alternately red and blue quarters. Blue stands for liberty, white for salvation, and red for the blood of heroes. The *state flag,* used by the government, has the Dominican coat of arms in its center. See **Flag** (picture: Flags of the Americas).
Money: *Basic unit*—peso. One hundred centavos equal one peso.

work for wages on large plantations, especially sugar plantations. Many Dominican farmers live in two-room shacks that have thatched roofs and dirt floors. But small bungalows built by the government are slowly replacing these shacks.

Most city dwellers earn a living as factory workers, as government employees, or by fishing. Many of them live in crowded, old Spanish-style apartment buildings. Dominicans dress in much the same way as people in the United States.

Dominicans love music that mixes the rhythmic pounding of African drums with the rattle of Spanish *maracas* (dried gourd shells with seeds and lead inside). Dominicans enjoy dancing the *merengue,* the national dance.

Most Dominicans are Roman Catholic. Some people who live near the Haitian border practice voodoo religions (see **Voodoo**).

Children between the ages of 7 and 14 must attend school. The government supplies most of the funds for most schools. A majority of Dominican adults can read and write. For the country's literacy rate, see **Literacy** (table: Literacy rates).

Land. The West Indies lie between the Atlantic Ocean and the Caribbean Sea. Hispaniola is formed by the peaks of two undersea mountain chains, one coming from Cuba and the other from Jamaica.

The Dominican Republic is a mountainous land. The *Cordillera Central* (Central Mountain Range) runs from northwest to southeast through the center of the country. Duarte Peak, which rises 10,417 feet (3,175 meters) above sea level in the Cordillera Central, is the highest point in the West Indies. The land west of the Cordillera Central is mostly dry and desertlike. Mountains in the west include Sierra de Neiba and the Sierra de Baoruco. Lake Enriquillo, the lowest point in the West Indies at 150 feet (46 meters) below sea level, lies between these mountains.

The *Cibao* lies north of the Cordillera Central. The *Cibao* is an area of pine-covered slopes and a fertile plain called the *Vega Real* (Royal Plain). It is the country's chief agricultural area. The *Cordillera Septentrional* (Northerly Range) is in the far north.

The eastern end of the Dominican Republic is less mountainous. Most of the country's sugar cane is grown along the southern coast east of Santo Domingo and in other eastern areas.

The Dominican Republic has a warm, tropical climate all year. Temperatures vary little and seldom go below 60 °F (16 °C) or above 90 °F (32 °C). The country averages about 60 inches (150 centimeters) of rainfall a year. The rainy season lasts from May to November in the south and from December to April in the north. Hurricanes sometimes strike the Dominican Republic.

Economy. The Dominican Republic is an agricultural country. About half of the working people are farmers. Most of the farmers work on their own small farms, or as sharecroppers for large landowners. Others rent land from large landowners. Large plantations, most of them owned by wealthy Dominicans and the government, also employ many farm workers. The broad, fertile plains are heavily farmed to produce avocados, bananas, mangoes, oranges, rice, sugar cane, and tobacco. In the forest-covered mountain foothills, coffee and *cacao beans* (seeds used to make chocolate) grow in the shade of fruit and mahogany trees.

Most manufacturing in the Dominican Republic is related to the processing of farm products, especially sugar cane. Refineries process about 1 million short tons (910,000 metric tons) of sugar cane annually, and about three-fourths of it goes to the United States. The people consume most of the rest or turn it into molasses and rum. Other manufactured products include cement and textiles.

Gold and nickel rank as the most important mining products of the Dominican Republic. The country also mines clay, gypsum, limestone, and salt. Salt is also produced by the evaporation of seawater.

Less than 2 percent of all Dominicans own an automobile. The country has an average of about 1 radio for every 6 people and about 1 television set for every 12 people. About 10 daily newspapers are published in the Dominican Republic. Santo Domingo has an international airport.

History. Christopher Columbus landed on Hispaniola on Dec. 6, 1492, on his first voyage to the New World. He ordered Fort Navidad built on the north coast from the ruins of his flagship, the *Santa Maria.* He returned in 1493 with 1,200 to 1,500 men to seek the island's gold. Columbus found that the Indians had wrecked the fort and killed the men he had left behind. Thousands of Spanish colonists soon came to Hispaniola. They conquered the Indians and established towns on the north

Georgio Ricatto, Shostal

A statue of Christopher Columbus stands in the Plaza Colón in Santo Domingo, the capital of the Dominican Republic.

coast. In 1496, they founded La Nueva Isabela (now Santo Domingo).

By the mid-1500's, the scarcity of gold in Hispaniola sent Spaniards in search of more promising lands. They moved on to Cuba, Mexico, and Peru. Hispaniola was neglected by Spanish trading vessels. Pirates and Dutch, English, and French merchants began trading with the small ports on the northern and western coasts.

In 1606, Spain ordered all Spanish settlers to move to the Santo Domingo area to strengthen the defense of Santo Domingo and increase trade for Spanish merchants there. This plan backfired when non-Spanish settlers moved into the abandoned lands in the interior and on the northern coast. By the Treaty of Ryswick of 1697, Spain turned over the western third of the island (now Haiti) to France. The French section prospered, but the Spanish section suffered from neglect. Black slaves in Haiti, led by Toussaint L'Ouverture and others, rebelled against their French masters and conquered the whole island by 1801. France and Spain recovered their colonies for brief periods after 1801, but the Haitians gained control of the island again in 1822.

Dominican heroes Juan Pablo Duarte, Francisco del Rosario Sánchez, and Ramón Mella led a successful revolt against the Haitians in 1844. From 1861 to 1865, at the Dominicans' request, Spain governed the country to protect it from the Haitians. Dictator Ulises (Lilis) Heureaux, who ruled the country from 1882 to 1899, left it in debt to several European nations. The United States took over the collection of customs duties in the Dominican Republic from 1905 to 1941 and used the money to pay the debts. From 1916 to 1924, U.S. Marines occupied the Dominican Republic to keep peace between rival political groups and to prevent *anarchy* (complete disorder) in the area during a critical time in world affairs.

Rafael Leonidas Trujillo Molina seized power in a military revolt in 1930. He ruled the Dominican Republic harshly for 30 years, allowing little freedom and imprisoning or killing many of his opponents. Trujillo carried out some beneficial projects, such as rebuilding Santo Domingo after a destructive hurricane in 1930. He ruled efficiently, and the country prospered economically. But the people gained little or no benefits, because all the profits were channeled to the Trujillo family.

Conspirators shot and killed Trujillo in 1961. A power struggle then began among the military, the upper class, the people who wanted a democracy, and those who favored Communism. Juan Bosch, a writer and popular foe of Trujillo who had been exiled, promised land and economic aid to the people. He was elected president in December 1962, but military and upper class leaders ousted him in September 1963. They said he allowed too many Communists in the government. Military leaders then formed a *junta* (council) to govern.

Rebels who supported Bosch tried to seize power in 1965. They captured parts of Santo Domingo, but met strong military opposition. President Lyndon B. Johnson sent U.S. troops to the Dominican Republic in April 1965 to maintain order. Some members of the Organization of American States also sent troops. A truce was arranged in May 1965. The last foreign troops left the country in September 1966.

In June 1966, Dominican voters elected Joaquín Balaguer president over Juan Bosch. Balaguer had previously served as president from 1960 to 1962, chiefly during the Trujillo dictatorship. Balaguer was reelected in 1970 and 1974. In 1978, Antonio Guzmán was elected president. In 1982, the voters elected Salvador Jorge Blanco president. Guzmán died a month before he was to leave office. Vice President Jacobo Majluta served as president until Blanco's term began.

In 1979, a hurricane killed more than 2,000 people and destroyed the homes of about 200,000 others in the country. The hurricane caused an estimated $1 billion worth of property damage.

Balaguer was elected president again in 1986. He was reelected in 1990 and 1994, but stepped down as president in 1996. Leonel Fernández Reyna was elected to succeed Balaguer. Balaguer ran for president again in 2000 but was defeated. Hipólito Mejía Domínguez, leader of the center-left Dominican Revolutionary Party, was elected as president.

Gary Brana-Shute

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Haiti
Roosevelt, Theodore (Foreign policy)
Santiago
Santo Domingo
Santo Domingo, University of West Indies

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The sugar cane crop is the Dominican Republic's most important product. Plantation workers cut most of the crop by hand.

Dominicans are members of a Roman Catholic religious order founded by Saint Dominic of Spain in the early 1200's. Its official name is the Order of Preachers.

Today, the Dominican order consists of about 123,000 men and women throughout the world. It is comprised of friars, priests, nuns, sisters, members of the *secular institutes*, and the *laity*. Members of secular institutes live in regular society but have taken religious vows. Members of the laity follow Dominican teachings but have not taken religious vows. From their founding until 1968, the Dominicans were divided into three orders. The First Order was made up of friars, the Second

Order was made up of nuns, and the Third Order, also known as tertiaries, was comprised of sisters and the laity. In 1968, the Dominican order eliminated the distinction between the three orders and adopted the name *the Dominican Family.*

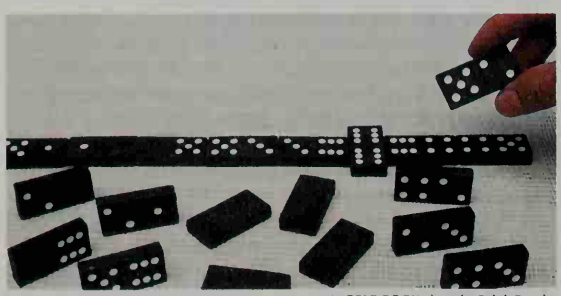
Saint Dominic established the Dominicans to oppose *heresy.* He founded the Second Order in 1206 and the First Order in 1216. Within a generation of their founding, Dominicans staffed theological faculties of major universities. The order included such famous theologians as Saint Albertus Magnus, Saint Thomas Aquinas, Johannes Eckhart, Saint Catherine of Siena, and Saint Martin de Porres. The emphasis on preaching, teaching, and theological study continues today. Ann Willits

See also **Dominic, Saint; Albertus Magnus, Saint; Aquinas, Saint Thomas; Catherine of Siena, Saint; Eckhart, Johannes; Friar.**

Dominoes, *DAHM uh nohz,* are small, flat, oblong tiles used to play a variety of games. Dominoes were probably invented in China, and introduced in Europe in the 1300's. Most sets of dominoes are made of bone, ivory, plastic, or wood. A regular set consists of 28 dominoes. A line divides each domino into two sections. Each section is marked with from zero to six dots. A section with no dots is called a *blank.* Every possible combination of dots appears in a domino set, and no two dominoes are alike.

The most common domino game is called *Draw Dominoes.* In this game, the players first place all the pieces facedown and mix them well. Then each chooses a certain number, usually seven if there are two playing, or five if there are three or four. The player with the highest *double domino* (piece with matching sections of dots) usually plays first. Suppose it is the 4-4. The player at the left plays next by matching any domino with four dots in one section to the 4-4 domino. For example, the matching domino may be the 4-6. The following player may then match a section with six dots to the 4-6 domino, or a section with four dots to the 4-4. *Single dominoes* (pieces with different sections of dots) are placed end to end. Double dominoes are placed at right angles to the line of pieces. Plays can be made on either end of a single domino. Plays can be made on both sides of a double, but not on the ends.

If the players cannot match from the dominoes they have chosen, they must draw from the *boneyard* (pile of unused tiles) until they find a domino that will match. After the boneyard is reduced to two dominoes—or in some games, is used up—players who cannot match dominoes must miss a turn, or *pass.*



WORLD BOOK photo by Ralph Brunke

In playing dominoes, each person matches a section of a domino with an identical section of an opponent's domino.

The game ends when one player runs out of dominoes or when no player can match any of the remaining dominoes with those he or she still holds. A player who goes out scores points equal to the number of dots on the other players' pieces. If no one goes out, the player with the fewest dots on unplayed dominoes scores the difference between this number and the number on the opponents' unplayed dominoes. In most games, the first player to reach 100 points wins. R. Wayne Schmittberger

Domitian, *duh MIHSH uhn* or *doh MIHSH ee uhn* (A.D. 51-96), succeeded his brother Titus as Roman emperor in A.D. 81. He was born on Oct. 24, A.D. 51, in Rome. His father, Vespasian, had been emperor from A.D. 69 to 79. When he became emperor, Domitian tried to restore old standards of conduct and religion and to control the greed of provincial governors. He settled a war with Dacia (now Hungary and Romania) by compromise and extended the Roman frontier in Germany. During his reign, people of other religions, such as Christians and Jews, were persecuted. His absolute rule made him unpopular with the Roman Senate. He was assassinated in his palace. F. G. B. Millar

Domus Aurea. See **Rome** (Other remains).

Don Juan, *dahn JOO uhn,* or, in Spanish, *dohn HWAHN,* is the hero of one of the most famous legends in literature. The legend originated in Europe during the Middle Ages. Its form became established in *The Trickster of Seville* (1630), a play by the Spanish author Tirso de Molina. In this work, the handsome nobleman Don Juan Tenorio seduces many women. But when he tries to seduce the daughter of the knight commander Don Gonzalo, Don Gonzalo challenges him to a duel. Don Gonzalo is killed by the hero. Don Juan visits the commander's tomb and scornfully invites the statue of his victim to dinner. The statue appears at the feast and returns the invitation, which Don Juan accepts. In the graveyard, the statue takes Don Juan's hand and drags him down into hell as apt punishment for his crimes against God and society.

The complex personality of Don Juan has fascinated writers and composers for hundreds of years. He has appeared in plays by Molière and George Bernard Shaw, an opera by Mozart, and a poem by Lord Byron. José Zorrilla's *Don Juan Tenorio* (1844) is the most popular treatment of the theme in modern Spanish literature. Each interprets Don Juan's personality differently. Harry Sieber

Don Quixote, *dahn kih HOH tee* or *dahn KWIHK suht,* is a novel by Miguel de Cervantes of Spain. Cervantes published the novel in two parts, in 1605 and 1615. Until the 1800's, *Don Quixote* was thought of as a humorous story of a madman's adventures. Then, it became a model for a new type of fiction with heroes who do not conform to their times.

The hero of *Don Quixote* is a Spanish landowner who enlivens his monotonous life by reading fictional tales about knights of old, which he believes to be true and accurate. Wishing to live like the knights, he takes the name Don Quixote of La Mancha, dresses in armor, and sets out to gain fame by performing heroic deeds. He attacks windmills he thinks are giants and flocks of sheep he mistakes for armies. The peasant Sancho Panza serves as Don Quixote's *squire* (attendant) during the

hero's adventures. Small, round Sancho riding his donkey contrasts with the tall, thin Don Quixote on his scrawny horse Rocinante. Sancho stands for the real in life, Don Quixote for the ideal. Their conversations together make up a large part of the novel.

Although beaten and scorned, Quixote still believes in his heroic destiny. When part two of the novel begins, he is amazed to discover that the first part of his life has been published. He must now live up to his literary fame. He loses faith in his destiny, becomes a prisoner of his imagined reputation, and is forced to behave as if he really believed in himself as a hero. Quixote finally regains his senses before he dies. Harry Sieber

See also **Spanish literature** (The 1600's).

Don River is an important waterway that is located in southwestern Russia. The Don rises from a small lake near Tula. It flows south for 1,220 miles (1,963 kilometers) and empties into the Sea of Azov. Large ships can sail on the Don for about 800 miles (1,300 kilometers). A canal connects the Don and Volga rivers. The northern part of the Don River flows through wooded, swampy land. But most of the river course is through rich farmlands. The river carries shipments of cement, grain, cattle, and lumber. The Don also has valuable fish, especially sturgeon. The city of Rostov is near the mouth of the Don. The chief branch of the Don is the Donets.

Leslie Dienes

Donatello, *DAHN uh TEHL oh* (about 1386-1466), was a great Italian sculptor. He was a master of all the techniques and materials of sculpture. Donatello seemed to have the ability to handle any subject in the most striking manner.

Donatello was born in Florence, and served as assistant to sculptor Lorenzo Ghiberti. From 1416 to about 1420, he carved the marble statue of *St. George* and the relief below it, *St. George Killing the Dragon* (see **Dragon** [picture]). The saint stands relaxed, as if deep in thought—an ideal example of the Christian knight. The remarkably flat relief shows an extensive landscape.

Donatello's effective use of realism appears in the statue of a prophet, known as *Lo Zuccone* (*The Pumpkinhead*), which he created about 1425. Late in life, Donatello began using distortion as he tried to show even more realistic emotional expression.

Donatello did three well-known statues of *David*. One of them is reproduced in the **Sculpture** article. His bronze *David* from the 1430's shows the influence of classical Greek sculpture on his own style (see **Renaissance** [picture: Donatello's *David*]). Donatello's other famous works include the bronze *equestrian monument* (man on horseback) of the Italian general *Gattamelata*. Donatello created the monument in Padua between 1443 and 1453. Roger Ward

Marble sculpture (c. 1415); Museo Nazionale, Florence (SCALA/Art Resource)

Donatello's *St. George*

See also **Sculpture** (Early Renaissance).

Donation of Constantine. See **Sylvester I, Saint.**

Donetsk, *dah NEHTSK* (pop. 1,117,000), is the largest city in the Donets River Basin. Donetsk is located in eastern Ukraine. For location, see **Ukraine** (political map).

Donetsk is in the center of the rich Donets coal fields. The coal is used in the huge iron and steel mills that make Donetsk an important industrial city. Machinery and food products are also produced there. The city was founded in the 1870's. Roman Szporluk

Donizetti, *DAHN ih ZEHT ee,* **Gaetano,** *GAH eh TAH now* (1797-1848), was an Italian opera composer. During his lifetime, he ranked second only to Gioacchino Rossini among Italian opera composers of his day. Donizetti wrote about 65 operas and operettas, and became famous for his beautiful, charming melodies and the dramatic pace and romantic vitality of his operas. Donizetti established his reputation with the opera *Anna Bolena* (1830).

Perhaps Donizetti's finest work is the comic opera *Don Pasquale* (1843). However, *L'Elisir d'amore* (*The Elixir of Love,* 1832) and *La Fille du régiment* (*The Daughter of the Regiment,* 1840) have also remained popular. Of his tragic operas, *Lucia di Lammermoor* (1835), with its famous sextet and "mad scene," is best known (see **Opera** [The Opera repertoire]). Donizetti is also known for the high literary quality of his many letters. He was born in Bergamo. Charles H. Webb

Donjon. See **Castle.**

Donkey is the name of the domesticated ass. The wild ass of northern and northeastern Africa is the ancestor of the donkey. This wild ass looks like a zebra with no stripes, except occasionally on the legs. It stands about 4 feet (1.2 meters) high at the shoulders. Its coat of hair is gray, with a darker line along its back. Other characteristics of the species are long ears, small feet, and long hair at the end of the tail. Selective breeding has resulted in donkeys that vary in size, color, and the length of their coat of hair.

American Donkey and Mule Society

The common domesticated donkey is used chiefly for riding and for pulling carts and wagons. This breed of donkey makes an ideal pet for children.

Thousands of years ago, people tamed the African wild ass and raised it for their own use. The domesticated donkey is most common in southern Asia, southern Europe, and northern Africa.

There are several varieties of the donkey. People use light, speedy donkeys for riding. Those of a larger, heavier breed draw carts or carry loads on their backs. The hardy donkeys do not require as much or as good food as horses require. However, they become stubborn and dull if badly treated. Female donkeys produce good milk.

A female donkey is called a *jenny* or a *jennet.* If a *jack* (male donkey) is mated with a *mare* (female horse), the animal that is born is a *mule* (see **Mule**). A cross between a female donkey and a *stallion* (male horse) is called a *hinny.* Small donkeys called *burros* are often used as pack animals because they are sure-footed. Other kinds of wild asses live on the dry plains of Asia. They include the *kiang, kulan,* and *onager* (see **Onager**). All wild asses are rare and face possible extinction.

Geo. H. Waring

Scientific classification. Donkeys are in the horse family, Equidae. The scientific name for domesticated donkeys and the African wild ass is *Equus asinus.*

Donne, *duhn,* **John** (1572-1631), was one of the greatest English poets and preachers of the 1600's. Donne was scholarly and had a keen, logical mind, but he was also deeply emotional. These qualities are evident in his poems and sermons. During his own time, Donne influenced several other poets. Donne and these poets were called the *metaphysical poets* (see **Metaphysical poets**).

His life. Donne was born in London. A descendant of Saint Thomas More, he was raised as a Roman Catholic. However, sometime during the 1590's, Donne became an Anglican. About 1597, he became secretary to Sir Thomas Egerton, a distinguished government official. In 1601, Donne secretly married Egerton's 16-year-old niece, Ann More. More's father was outraged at the marriage and had Donne dismissed from his position and finally imprisoned.

For the next 14 years, Donne struggled to support himself and his growing family, often living on the generosity of patrons. In 1615, at the urging of King James I, Donne became an Anglican priest. Donne also received a Doctor of Divinity degree from Cambridge. He quickly became famous for his sermons and often preached at the royal court. In 1621, Donne became dean of St. Paul's Cathedral, holding this position until his death.

His poetry. Donne wrote poetry on a variety of subjects and used many different *genres* (poetic types). His early *Satires* and *Elegies* follow classical models, but they also have a distinctly modern flavor. In *Songs and Sonnets,* his best-known group of poems, Donne wrote both tenderly and cynically of love. His major love poems include "The Canonization" and "The Extasie."

Later, Donne turned to writing religious poetry. He produced a superb series of *Holy Sonnets,* including "Death be not proud" and "Batter my heart, three person'd God." Donne also wrote a moving meditative poem called "Good Friday, 1613. Riding Westward" and three magnificent hymns. He wrote nearly 200 poems, but only a few were published during his lifetime. The others circulated in manuscript copies and were not published until 1633. Donne's poetry was somewhat ignored during the 1700's and 1800's, but in the early 1900's, interest in his poetry revived. Modern poets, including T. S. Eliot, have praised and imitated Donne's works.

Donne's language is dramatic, witty, and sometimes shocking. He used a variety of imagery and based his rhythms on everyday speech. At times, the complexity of his thought makes his meaning difficult to understand, but his poems always unfold in a logical way. He had a genius for creating extended poetic metaphors called *conceits.* In the metaphysical conceit, the poet developed a lengthy, complex image to express precisely his view of a person, object, or feeling. Donne's lyric "A Valediction: Forbidding Mourning" contains his most famous conceit. Donne compares the souls of separated lovers to the legs of a compass:

> If they be two, they are two so
> As stiffe twin compasses are two,
> Thy soule the fixt foot, makes no show
> To move, but doth, if th' other do.

Gary A. Stringer

See also **English literature** (Metaphysical and Cavalier poets).

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Donnelly, Ignatius (1831-1901), was an American politician, reformer, and author who helped form the Populist Party. He served in the U.S. House of Representatives from 1863 to 1869 as a Republican congressman from Minnesota, then later quit the party.

Donnelly wrote part of the Populist Party platform in 1892 (see **Populism**). This platform called for a federal income tax, government ownership of railroads, an eight-hour workday, and unlimited coinage of silver (see **Free silver**).

Donnelly was born in Philadelphia, and moved to Minnesota in 1857. He wrote several books, including one on his own theory of the earth's collision with a comet and one on Francis Bacon's supposed writing of Shakespeare's plays. Charles B. Forcey and Linda R. Forcey

Donner Pass cuts through the Sierra Nevada, a mountain range in eastern California. The pass was the scene of a great tragedy in the severe winter of 1846-1847. A party of 82 settlers from Illinois and adjoining states, led by George and Jacob Donner, became snowbound there, and only 47 survived. They built crude shelters of logs, rocks, and hides, and ate twigs, mice, their animals, and their shoes. Finally, the settlers ate their own dead.

The party reached the High Sierras in late October, but a snowstorm had already closed the pass. In December, 15 people tried to get through the snow-blocked pass. Eight of them died, but seven got through and sent back rescue workers. The rescue workers brought the other 40 survivors through the pass.

Donner Pass lies 7,088 feet (2,160 meters) above sea level, about 35 miles (56 kilometers) southwest of Reno, Nevada. The first transcontinental railroad system, com-

pleted in 1869, went through the pass. Donner Pass is a national historical landmark. The area is now a summer resort and ski resort. Tom L. McKnight

Doodlebug. See Ant lion.

Dooley, Thomas Anthony, III (1927-1961), an American physician, became famous in the 1950's as the *jungle doctor of Laos.* As a medical officer in the U.S. Naval Reserve, he served on a ship that carried Southeast Asian refugees. He also organized refugee camps in Vietnam. He left the Navy in 1956 to start a private, mobile medical unit in Laos. In 1957, Dooley helped found MEDICO (Medical International Cooperation Organization). He helped finance MEDICO with funds from lecture tours and books he wrote.

Dooley's three books—*Deliver Us from Evil* (1956), *The Edge of Tomorrow* (1958), and *The Night They Burned the Mountain* (1960)—describe his experiences in Southeast Asia. At the age of 34, Dooley died of cancer. After his death, Congress awarded him a gold medal for his humanitarian work. Dooley was born on Jan. 17, 1927, in St. Louis. Kenneth R. Manning

Doolittle, Hilda (1886-1961), an American poet, was a leader of the Imagism movement in poetry during the early 1900's. Doolittle's style reflects Imagism's emphasis on the clear, precise, and objective treatment of images, scenes, and events. She was strongly influenced by classical literature, especially Greek verse. Many of her poems deal with Greek mythology. She also wrote three long poems about her experiences in London during World War II (1939-1945). The poems are *The Walls Do Not Fall* (1944), *Tribute to the Angels* (1945), and *The Flowering of the Rod* (1946).

Doolittle was born on Sept. 10, 1886, in Bethlehem, Pennsylvania. She moved to Europe in 1911 and lived primarily in London and in Switzerland until her death. During the early 1930's, Doolittle was psychoanalyzed by the Austrian psychiatrist Sigmund Freud. She provided a fascinating account of her treatment in *Tribute to Freud* (1956). She also wrote novels and verse plays and translated ancient Greek poetry and drama. She wrote all her works under the initials H. D. Elmer W. Borklund

Doolittle, James Harold (1896-1993), a noted American flier, led the first bombing raid on Tokyo in World War II. He led 16 B-25 twin-engine bombers, normally land-based planes, from the deck of the aircraft carrier U.S.S. *Hornet* in the surprise attack on Tokyo on April 18, 1942. Congress awarded him the Medal of Honor for this daring raid.

A lieutenant colonel when he led his raid, Doolittle rose to lieutenant general during World War II. He commanded the 12th Air Force in the North African invasion in 1942, and later the 15th Air Force in the Mediterranean area. In 1944 and 1945, he was commander of the 8th Air Force, which bombed western Europe. He also commanded the 8th Air Force on Okinawa after Germany surrendered.

Doolittle was born on Dec. 14, 1896, in Alameda, California, and graduated from the University of California. He was an Army aviator during World War I. Doolittle left the Army in 1930 to work for the Shell Petroleum Corporation. He returned to military duty in 1940.

Doolittle was chairman of the National Advisory Committee for Aeronautics from 1956 to 1958. He was director of the Space Technology Laboratories, an aerospace firm, from 1959 to 1962. Alfred Goldberg

See also **Airplane** (table: Speed records); **World War II** (The tide turns).

Doom palm. See Doum palm.

Doomsday Book. See Domesday Book.

Dopamine, *DOH puh meen,* is a chemical that acts in the brain to influence a wide range of feelings and behaviors, including paying attention, planning, and moving the body. Dopamine also plays a key role in motivation, pleasure, and addiction. Dopamine is one of a group of chemicals called *neurotransmitters,* which carry information from one *neuron* (nerve cell) to another.

The brain has a network of nerve cells that produce dopamine or respond to it. Deep inside the brain are two small clusters of dopamine-producing cells. These cells contain a chemical pathway that changes an amino acid called *tyrosine* first into a chemical called *L-dopa* and then into dopamine. Nerve cells that respond to dopamine have structures called *dopamine receptors* on their surface. There are five types of dopamine receptors. The effects of dopamine depend on where it is released, how much is released, and which types of receptors are activated. Brain levels of dopamine are highest in infancy, then decrease throughout life.

Many physical and mental disorders involve too much or too little dopamine. For example, all addicting drugs seem to raise dopamine levels in the same part of the brain. In people who develop addictions, these dopamine surges cause long-term, even permanent, changes in brain cells. Certain movement disorders, such as Parkinson disease, involve abnormal dopamine levels. Disruption of dopamine also plays a role in other condisions, including schizophrenia, attention deficit disorder, and Tourette syndrome. F. Xavier Castellanos

See also **Brain** (The brain's chemical messengers; picture: Networks of neurons); **Parkinson disease; Schizophrenia; Tourette syndrome.**

Doppler effect is the change in frequency of sound, light, or radio waves caused by the relative motion of the source of the waves and their observer. For example, the *pitch* (frequency) of a train whistle seems higher when the train approaches and lower after it passes. The actual pitch of the whistle remains constant. Astronomers study the speed of a star by measuring the apparent change in the frequency of its light waves caused by motion. Christian Doppler, an Austrian physicist, described the effect in 1842. Thomas A. Griffy

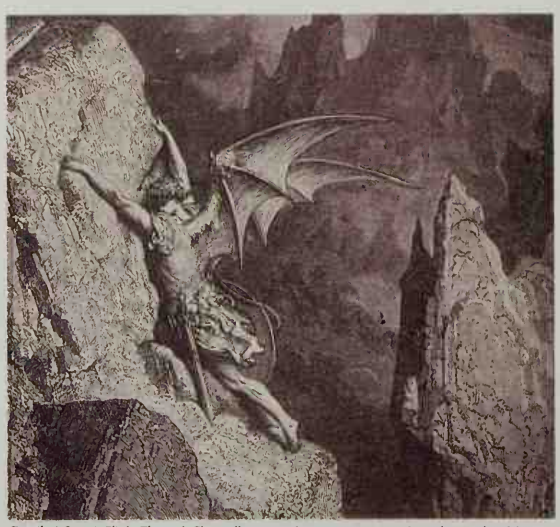
See also **Log** (diagram: The Doppler log); **Radar** (Continuous-wave radar); **Relativity** (General relativity); **Sound** (The speed of sound); **Sun** (Studying the sun).

Dorado. See **Dolphin** (fish).

Dorchester, Baron. See **Carleton, Sir Guy.**

Doré, *daw RAY,* **Gustave,** *goo STAV* (1832-1883), a French painter and sculptor, illustrated a large number of literary masterpieces. These include the Bible, the works of Rabelais and Balzac, Dante's *Divine Comedy,* LaFontaine's *Fables,* Tennyson's *Idylls of the King,* Cervantes's *Don Quixote,* Coleridge's "The Rime of the Ancient Mariner," and Poe's "The Raven." Doré's style is dramatic and imaginative. However, sometimes it is repetitious.

Doré was born Paul Gustave Doré in Strasbourg, Alsace-Lorraine. As a boy, he showed a remarkable talent for drawing. His work was in great demand while he



Detail of *Satan's Flight Through Chaos;* illustration from *Masterpieces from the Works of Gustave Doré.* © 1887 Cassell Publishers

A Doré engraving illustrates an edition of *Paradise Lost* by John Milton. Doré's engravings rank among his best works.

was still quite young. His fame outside of France rests chiefly on his illustrations. Elizabeth Broun

See also City (picture: The Industrial Revolution).

Dore metal. See Assaying (Dry assaying).

Dorians, *DAWR ee uhnz,* were a group of ancient Greeks. They lived in the northwestern part of the Greek mainland before 1200 B.C. According to Greek tradition, the Dorians overran most of the *Peloponnesus* (the southern peninsula of Greece) toward the end of the 1100's. The best-known Greeks of Dorian descent were the Spartans. In addition to Sparta, Dorian cities included Argos, Corinth, Megara, and Rhodes. Dorians also settled in Crete, Sicily, southern Italy, the Sporades Islands, and southwestern Asia Minor (present-day Turkey).

Some scholars have questioned whether the Dorians actually existed. Information about them comes mostly from later Greek traditions. Norman A. Doenges

See also Achaeans; Aeolians; Corinth; Greece, Ancient (History); Ionians; Mycenae; Sparta.

Dorion, *daw RYAWN,* **Marie** (1790?-1850), an American Indian, became known for her bravery as a member of the Astor Overland Expedition. She was the only woman on this 3,500-mile (5,630-kilometer) trip. The expedition left St. Louis in March 1811 and reached Astoria, a fur-trading post in the Oregon region, in February 1812.

Dorion's husband, Pierre, was an interpreter on the trip, and their two small sons accompanied them. The expedition walked most of the way, and Marie had more endurance than almost all the men. In December, she gave birth on the trail. The next day, she rode about 20 miles (32 kilometers) on horseback to rejoin the group. The infant died nine days later.

During the winter of 1814, Pierre Dorion and the other men were killed by Indians in Oregon. Marie and her two sons escaped into the mountains, where she built a shelter. Because of the severe cold and deep snow, she and the children stayed in the shelter for 53 days. She killed their horse to provide nourishment.

Marie Dorion, a member of the Iowa tribe, was also called *Marie Iowa* or *Marie Aioe.* Historians know little about her early life. Priscilla Giddings Buffalohead

Dormancy. See Germination.

Dormouse, *DAWR mows,* is a tiny mammal that looks like a small squirrel. Dormice are well known for their sleepy ways. When cold weather arrives, they stock a nest with food and *hibernate* (sleep through the winter). They may wake up on warm winter days and eat some of their food. In *Alice's Adventures in Wonderland,* author Lewis Carroll described a humorous dormouse that could not be kept awake at a tea party.

The dormouse has fine, silky fur, a pointed nose, and

WORLD BOOK illustration by John D. Dawson

The tiny dormouse has a pointed nose and a long tail.

big black eyes. Its body is about 3 inches (8 centimeters) long, and so is its tail. Dormice are rodents, and are related to mice and rats. They live in trees and bushes in parts of Africa, Asia, and Europe. Dormice hunt for food at night, and eat berries, grains, and nuts.

Scientific classification. Dormice belong to the dormouse family, Gliridae. There are several genera. Clyde Jones

Dörpfeld, Wilhelm. See Troy (The archaeological Troy).

Dorr Rebellion was an uprising against the state government of Rhode Island in 1842. It was led by Thomas W. Dorr, a Providence lawyer who thought the state government was undemocratic. The rebellion failed, but it helped bring about a new constitution.

At the time of the rebellion, Rhode Island was still governed by its colonial charter of 1663. Landholding conservatives held all the power because people without land did not have the right to vote. The landless, including many immigrants, could not convince the conservatives to draft a more democratic constitution.

Dorr and other radicals drew up a new constitution, which voters unofficially ratified in 1841. The following April, Dorr and his followers held their own elections, and Dorr was elected governor. But the conservatives refused to recognize the radical government.

The radicals believed in the right of the people to overthrow an unjust government. As a result, Dorr formed an army and attempted to take power by force. But the army suffered two humiliating defeats, and Dorr fled the state. The conservatives, anxious to avoid future uprisings, drafted a new constitution almost as demo-

cratic as the radicals' constitution. The constitution took effect in 1843. Dorr returned to Rhode Island. He was convicted of treason and imprisoned in 1844 but was released in 1845. Marvin E. Gettleman

Dos Passos, *dohs PAS ohs,* **John** (1896-1970), was an American novelist whose work is dominated by social and political themes. His experiments in fiction earned him distinction as an avant-garde novelist in the 1920's and 1930's (see **Avant-garde**).

Dos Passos first achieved fame with his World War I novels, *One Man's Initiation* (1917) and *Three Soldiers* (1921). *Three Soldiers* protests the impact of war on civilization and art. *Manhattan Transfer* (1925) reveals Dos Passos's disillusioned response to postwar urban America. This novel led to his most famous work, the *U.S.A.* trilogy, which pessimistically surveys the disintegration of U.S. culture that Dos Passos believed took place in the early 1900's. The trilogy consists of *The 42nd Parallel* (1930), *1919* (1932), and *The Big Money* (1936).

U.S.A. brings together many characters in a wide variety of episodes. Dos Passos featured a technique called the Newsreel, which used newspaper headlines, words from popular songs, and advertisements to surround the action and characters. Another technique, called The Camera's Eye, gives the author's view of his subject. Dos Passos regarded his style as providing a social and historical background in which individual actions reflected the often desperate larger patterns he saw in United States society.

John Roderigo Dos Passos was born in Chicago and attended Harvard University. He was a political liberal in his early years, but moved sharply toward conservatism by the 1940's. His *District of Columbia* trilogy—*Adventures of a Young Man* (1939), *Number One* (1943), and *The Grand Design* (1949)—reveals his conservative attitudes. Dos Passos also wrote *Mr. Wilson's War* (1962), a history of World War I. Samuel Chase Coale

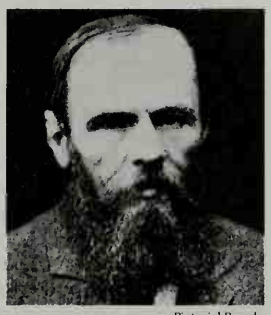
Dostoevsky, *DAHS tuh YEHF skee,* **Fyodor,** *FYAW dahr* (1821-1881), was one of the greatest writers in Russian literature. Dostoevsky's finest works are novels of ideas, embodied in great characters. His intensely individual and highly complex characters are usually caught up in very dramatic plots. The underlying theme in his books is the struggle between good and evil for dominance of the human soul. Dostoevsky attempts to resolve this struggle by leading his characters to salvation through purifying suffering.

Fyodor Mikhailovich Dostoevsky was born in Moscow. He received a military engineering education in St. Petersburg, but decided to follow a literary career. Dostoevsky's first novel was *Poor Folk* (1846), a psychological study written in letter form. His next book, *The Double* (1846), is the complex story of an unpopular civil servant who goes mad and sees his own double. During the late 1840's, Dostoevsky wrote many stories about the poor and the downtrodden as well as strange and abnormal residents of St. Petersburg.

In 1847, Dostoevsky joined the Petrashevsky circle, a group of socialists who met to read and discuss political and economic books banned by the government. In 1849, police arrested the members of the circle. Dostoevsky and several others were condemned to death by a firing squad. By order of the czar, they were pardoned moments before they were to die. Dostoevsky was then sentenced to four years of hard labor in a Siberian prison and then served four years as a common soldier.

After returning to St. Petersburg in 1859, Dostoevsky wrote *Notes from the House of the Dead* (1860-1862). It is a fictionalized version of his prison experiences and one of the great prison works in Western literature. Years of bitter, poverty-stricken existence followed for Dostoevsky. He was plagued by financial difficulties due to poor money management and a gambling habit.

Dostoevsky achieved success with *Notes from Underground* (1864), a psychological study of a spiritual and intellectual misfit. His greatest success came with four novels that rank among the masterpieces of world literature. *Crime and Punishment* (1866) concerns a student who murders because he imagines himself to be superior to most people, but who cannot face the enormity of his crime. In *The Idiot* (1868-1869), Dostoevsky tried to portray a truly good Christian person. *The Possessed* (1871-1872), also published as *The Devils*, is a prophetic portrait of Russian revolutionaries. Dostoevsky's greatest novel is probably *The Brothers Karamazov* (1879-1880). It centers on the murder of the evil Fyodor Karamazov and the effect of this crime on each of his four sons.



Pictorial Parade

Fyodor Dostoevsky

His later works show Dostoevsky to be a pioneer in psychological analysis and an important and original religious thinker. As an interpreter of the human condition, he anticipated many of the ideas of the philosophical movement called *existentialism.* Anna Lisa Crone

See also **Russian literature** (The 1860's and 1870's).

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Douala, *du AH lah* (pop. 1,029,731), is the largest city and chief seaport of Cameroon. It lies along the Wouri River, about 15 miles (24 kilometers) from where the river flows into the Gulf of Guinea, an arm of the Atlantic Ocean (see **Cameroon** [map]).

Busy docks line parts of Douala's waterfront. A bridge that is 5,910 feet (1,800 meters) long spans the Wouri River in Douala. The city has open squares, a cathedral, and a museum. Shipping and related businesses are the chief economic activities. Other activities in the Douala area include banking; cacao processing; and the production of beer, cement, fertilizer, leather, matches, shoes, tobacco goods, and textiles.

The city is named for the Douala people, who have lived in the area for hundreds of years. The Douala established a number of villages there. The Germans, who ruled the area from 1884 to 1916, built the city on the site of the villages. Douala was enlarged by the French, who governed it from 1919 to 1960. Dennis D. Cordell

Douay Bible. See **Bible** (Early English translations).

Double star. See Binary star.

Doubleday, Abner (1819-1893), was a United States Army officer who was once considered the inventor of baseball. In order to settle a dispute over the origin of the game, Albert G. Spalding, a sporting-goods manufacturer and former ballplayer, suggested the appointment of a commission to study the matter. The commission's report, published in 1908, credited Doubleday with inventing the game in Cooperstown, New York, in 1839. In honor of Doubleday, Cooperstown residents established the National Baseball Hall of Fame and Museum in the town. The Hall of Fame operates under the jurisdiction of professional baseball. Most historians today claim that Doubleday had little, if anything, to do with baseball. They believe the sport probably developed from an English game called *rounders*. See **Baseball** (History [The Abner Doubleday theory]).

Doubleday was born on June 26, 1819, in Ballston Spa, New York. He graduated from the United States Military Academy in 1842, and he served in the Mexican War (1846-1848). Doubleday became a major general in the Union Army during the American Civil War (1861-1865). He commanded the troops at Fort Sumter that fired the first shots by the North in the Civil War. Doubleday also fought heroically at the Battle of Gettysburg. Jack Lang

Doublet, in clothing, see **Clothing** (The Renaissance); in jewelry, see **Gem** (Imitation and synthetic gems).

Doubloon, *duh BLOON,* is a Spanish and Spanish-American gold coin that was widely used in America until the 1800's. The name comes from the Latin *duplus,* meaning *double.* The doubloon was equal to four *pistoles* (16 silver dollars). It was also called *doblón de a ocho* meaning *doubloon of eight,* because it was worth eight gold escudos. It weighed about 27 grams (slightly less than 1 ounce). Burton H. Hobson

Doughnut is a round, fried cake with a hole in the center. Dutch settlers brought the fried cake to colonial America. A legend suggests that Hanson Gregory of the United States invented the doughnut hole in 1847 at the age of 15. Gregory supposedly recommended that his mother cut the centers from her fried cakes so they would cook more thoroughly. Kay Franzen Jamieson

Douglas. See Man, Isle of.

Douglas, Sir James (1803-1877), served as the first governor of the colony of British Columbia, in what is now Canada. Douglas held the office from 1858 to 1864.

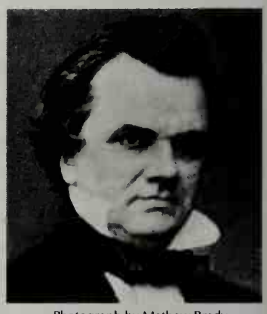
Douglas was born on Aug. 15, 1803, in Demerara, British Guiana (now Guyana), and was educated in the United Kingdom. In 1820, he went to Quebec as an employee of the North West Company, a British fur-trading firm. The Hudson's Bay Company, a rival organization, took over the North West Company in 1821.

From 1839 to 1858, Douglas served as chief officer in the Columbia territory for the Hudson's Bay Company. In 1843, he founded Fort Victoria (now Victoria) as headquarters for the company. The fort stood on Vancouver Island, which today forms part of British Columbia. Vancouver Island became a British colony in 1849, and Douglas served as governor from 1851 to 1863. He was knighted in 1863. P. B. Waite

Douglas, Norman (1868-1952), a British novelist and essayist, is best known for his witty and satirical novel *South Wind* (1917). The book is set on an imaginary island called Nepenthe, based on the island of Capri. The word *nepenthe* means a drug capable of banishing sorrow and fear. The central theme of *South Wind* is the nature of truth. Thomas Heard, an Anglican bishop, receives an education in the complexity of truth and a doctrine of individualism. Douglas's books about the Mediterranean region include *Siren Land* (1911), *Fountains in the Sand* (1912), and *Old Calabria* (1915). He wrote two other novels, *They Went* (1921) and *In the Beginning* (1928). George Norman Douglas was born on Dec. 8, 1868, near Aberdeen, Scotland, but lived most of his life abroad, primarily in Italy. Garrett Stewart

Douglas, Stephen Arnold (1813-1861), was a popular and skillful American orator and political leader just before the Civil War (1861-1865). He is best known for his debates with Abraham Lincoln on the question of slavery. These debates ranked as noteworthy events in the history of the United States. See **Lincoln, Abraham** (The debates with Douglas).

Douglas was born on April 23, 1813, on a farm near Brandon, Vermont. Politics interested him, and he wanted to become a lawyer. At the age of 20, he went to Illinois. He was admitted to the bar at Jacksonville, Illinois. Douglas, a Democrat, was elected prosecuting attorney for his district in 1835. The next year, he was elected to the state legislature. He was judge of the Supreme Court of Illinois from 1841 to 1843. Douglas was elected to the United States House of Representatives in 1843 and became a member of the U.S. Senate in 1847.



Photograph by Mathew Brady. National Archives, Washington, D.C.

Stephen A. Douglas

Douglas was a short man, with a large head and broad shoulders. Because of his appearance, he received the nickname the *Little Giant.* He won respect in the Senate for his ability, energy, and fearlessness, and became chairman of the Senate committee on territories. More than any other person, Douglas helped win passage of the Compromise of 1850. This compromise was a series of laws that temporarily eased tensions over slavery. See **Compromise of 1850.**

The slavery controversy was the great issue of the mid-1800's. As each territory applied for admission to the Union, a storm of debate arose in Congress as to whether the new state should be free or slaveholding. Douglas believed that the people of the territories should decide for themselves whether they wanted slavery. He called this principle *popular sovereignty.* It was also called *squatter sovereignty* (see **Popular sovereignty**). Douglas's committee reported the famous Kansas-Nebraska Bill in 1854. The bill included the principle of popular sovereignty (see **Kansas-Nebraska Act**). Douglas was chiefly responsible for the passage of this much-disputed bill.

When Douglas ran for reelection to the Senate in 1858, his Republican opponent was Abraham Lincoln, a man then almost unknown outside Illinois. Douglas and Lincoln held a series of public meetings in which they debated the problem of slavery and its extension. These

meetings attracted the attention of the entire country.

Douglas argued that the people must have the right to control slavery. Lincoln said that a nation half-slave and half-free could not exist. Douglas won his reelection to the Senate, but some of his speeches in the debates displeased Southern Democrats. Douglas was a candidate for the Democratic presidential nomination in 1860, but only Northern Democrats supported him. The Democratic Party split its votes among three candidates. Douglas received only 12 electoral votes, though he achieved the second highest popular vote. The Republican candidate, Abraham Lincoln, won the election.

Douglas supported President Lincoln and the Union when the Civil War broke out. "There can be no neutrals in this war," he declared, "only patriots—or traitors." Douglas died a few months later. He was buried in a small park in Chicago. Gabor S. Boritt

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Douglas, Thomas. See Selkirk, Earl of.

Douglas, William Orville (1898-1980), served on the Supreme Court of the United States longer than any other justice. Douglas served as an associate justice from 1939 to 1975. He gained renown not only because of his work as a member of the Supreme Court, but also because of his wide travels and his books dealing with problems in America's national and international life.

On the Supreme Court, Douglas strongly supported government protection of civil liberties, civil rights, and the environment. His books include *Of Men and Mountains* (1950) and *Strange Lands and Friendly People* (1951). Douglas also wrote *The Anatomy of Liberty* (1963) and *Points of Rebellion* (1970).

Douglas was born on Oct. 16, 1898, in Maine, Minnesota, and graduated from Whitman College. He received his law degree from Columbia University and established a national reputation as a law teacher at Yale University. In 1936, he became a member of the Securities and Exchange Commission. He served as chairman of the commission from 1937 to 1939. Bruce Allen Murphy

Douglas-fir is one of the largest and most valuable timber trees in the world. This *conifer* (cone-bearing tree) is the source of more lumber than any other species of tree in North America. It is common in the western United States and Canada, both in the Pacific Coast region of the Rocky Mountains. The Douglas-fir is not a true fir. It belongs to a separate *genus* (group) in the pine family.

The flat needles of a Douglas-fir are about 1 inch (2.5 centimeters) long. The egg-shaped cones have odd, three-pointed *bracts* (leaflike structures). In the Pacific Northwest, Douglas-firs grow from 180 to 250 feet (55 to 76 meters) tall and up to 8 feet (2.4 meters) thick through the trunk.

Douglas-firs may live up to 800 years. Forests of older trees are economically valuable, but they also provide a home for rare plants and animals that cannot live anywhere else. As a result, there is much disagreement about how these forests should be managed. The Douglas-fir is the state tree of Oregon. Douglas G. Sprugel

Grant Heilman

The Douglas-fir towers above most other trees in the evergreen forests of the western United States and Canada. It provides more lumber than any other kind of North American tree.

Scientific classification. The Douglas-fir belongs to the pine family, Pinaceae. It is *Pseudotsuga menziesii.*

See also **Conifer; Pine; Spruce; Tree** (picture: Familiar broadleaf and needleleaf trees).

Douglas-Home, *hyoom,* **Sir Alec** (1903-1995), was prime minister of the United Kingdom from October 1963 to October 1964. A member of the Conservative Party, he succeeded Harold Macmillan. He served as foreign secretary from 1960 to 1963 and from 1970 to 1974.

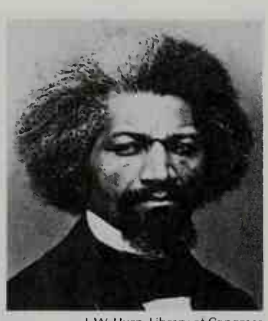
Home served as a Conservative member of the House of Commons from 1931 to 1945. In 1945, he became joint parliamentary undersecretary of state for foreign affairs. After his father's death in 1951, Home became the 14th Earl of Home. As a member of the nobility, Home took his place in the House of Lords. He became secretary of state for Commonwealth relations in 1955 and leader of the House of Lords in 1957.

After Home was named prime minister, some members of the Conservative Party protested his being selected. Traditionally, the prime minister must be a member of the House of Commons, and Home was not a member. The protesters were also upset because party leaders had disregarded many members' wishes by choosing Home. But after Home became prime minister, he gave up his title and his seat in the House of Lords and was again elected to the Commons. In 1975, Queen Elizabeth II gave him the title Baron Home of the Hirsel, and he returned to the House of Lords.

Home was born on July 2, 1903, in London. His full name was Alexander Frederick Douglas-Home. He grew up at his ancestral home in Berwickshire in Scotland. Richard Rose

Douglass, Frederick (1818?-1895), was the leading spokesman of African Americans in the 1800's. Born a slave, Douglass became a noted reformer, author, and orator. He devoted his life to the abolition of slavery and the fight for black rights.

Frederick Augustus Washington Bailey was born on Feb. 7, 1817, in Tuckahoe, Maryland. At age 8, he was



J. W. Hurn, Library of Congress
Frederick Douglass

sent to Baltimore to work for one of his master's relatives. There, helped by the wife of his new master, he began to educate himself. He later worked in a shipyard, where he *caulked* ships, making them watertight.

In 1838, the young man fled from his master and went to New Bedford, Massachusetts. To avoid capture, he dropped his two middle names and changed his last name to Douglass. He got a job as a caulker, but the other men refused to work with him because he was black. Douglass then held unskilled jobs, among them collecting rubbish and digging cellars.

In 1841, at a meeting of the Massachusetts Antislavery Society, Douglass told what freedom meant to him. The society was so impressed with his speech that it hired him to lecture about his experiences as a slave. In the early 1840's, he protested against segregated seating on trains by sitting in cars reserved for whites. He had to be dragged from the white cars. Douglass also protested against religious discrimination. He walked out of a church that kept blacks from taking part in a service until the whites had finished participating.

In 1845, Douglass published his autobiography, *Narrative of the Life of Frederick Douglass.* He feared that his identity as a runaway slave would be revealed when the book was published, so he went to England. There, Douglass continued to speak against slavery. He also found friends who raised money to buy his freedom.

Douglass returned to the United States in 1847 and founded an antislavery newspaper, the *North Star,* in Rochester, New York. In the 1850's, Douglass charged that employers hired white immigrants ahead of black Americans. He once declared: "Every hour sees the black man elbowed out of employment by some newly arrived emigrant whose hunger and whose color are thought to give him a better title to the place." He accused even some abolitionist business executives of job discrimination against blacks.

Douglass also led a successful attack against segregated schools in Rochester. His home was a station on the underground railroad, a system which helped runaway slaves reach freedom (see **Underground railroad**).

During the American Civil War (1861-1865), Douglass helped recruit African Americans for the Union Army. He discussed the problems of slavery with President Abraham Lincoln several times. Douglass served as recorder of deeds in the District of Columbia from 1881 to 1886 and as U.S. minister to Haiti from 1889 to 1891. He wrote two expanded versions of his autobiography—*My Bondage and My Freedom* (1855) and *Life and Times of Frederick Douglass* (1881). Otey M. Scruggs

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Doukhobors, *DOO kuh bawrz,* also spelled *Dukhobors,* belong to a Christian sect in western Canada. *Doukhobors* is a Russian word meaning *spirit wrestlers.* They believe the "voice within" each person is his or her guide. Therefore, the Doukhobors see no need for churches or governments. Doukhobors are pacifists.

Peasants founded the sect in Russia in the mid-1700's. The Doukhobors adopted many of the ideas of the Russian author Leo Tolstoy in the late 1800's, under the leadership of Peter Verigin. In 1899, Tolstoy and English and American Quakers helped more than 7,000 Doukhobors emigrate to western Canada. There they established communal farms. The group still survives, but its communal life has largely died out. A small group of Doukhobors called the *Sons of Freedom* wishes to restore the communal communities in Canada or in any country that would welcome them. Ivan Avakumovic

Doum palm, *doom,* also spelled *doom palm,* grows in Arabia, Upper Egypt, and Central Africa. Each branch of the doum palm ends in a tuft of deeply lobed, fan-shaped leaves. The tree bears an irregularly oval fruit about the size of an apple. The fruit has a red outer skin and a thick, spongy, and rather sweet inner substance that tastes like gingerbread. For this reason, the doum palm has often been called the *gingerbread tree.* Large quantities of these fruits have been found in the tombs of the Egyptian pharaohs. The seeds are a source of *vegetable ivory.* James D. Mauseth

Scientific classification. The doum palm belongs to the palm family, Arecaceae or Palmae. Its scientific name is *Hyphaene thebaica.*

Dove is the name generally given to smaller birds in the pigeon and dove family. The name *pigeon* usually refers to larger birds of this family. Doves live throughout most of the world. Their habitats range from desert-like areas to tropical forests.

Doves have small heads on plump, compact bodies. Their long wings are powered by large flight muscles, which can make up almost 40 percent of the bird's body weight. One of the most common doves, the mourning dove, reaches about 12 inches (30 centimeters) in length. The smallest dove, the diamond dove, grows only about 6 to 8 inches (15 to 20 centimeters) long.

Doves eat seeds, nuts, fruits, and insects. The bird's *crop,* a sac in the base of the neck, produces a nutritious food called *crop milk* or *pigeon's milk.* Both male and female doves feed crop milk to their young.

Doves commonly choose one mate for each breeding season, though a few mate for life. During courtship, male doves attract female doves by cooing. The birds place their nests on the ground or in bushes, trees, or hollows. Female doves usually lay two eggs.

Edward H. Burtt, Jr.

Scientific classification. Doves are in the pigeon and dove family, Columbidae. The scientific name of the diamond dove is *Geopelia cuneata.* The mourning dove is *Zenaida macroura.*

See also **Pigeon; Mourning dove; Turtle dove.**

Dove, Arthur Garfield (1880-1946), was one of the earliest abstract painters in the United States. He created his first symbolic abstract pictures of nature in 1910, long before abstract art was common in America. Most

of his compositions involve subjects drawn from nature and landscape. Dove's abstract designs, generally small in size, emphasized areas of solid color, often earthy in tone. During the 1920's, he also made collaged constructions (see **Collage**).

Dove was born in Canandaigua, New York, and gained early success as a magazine illustrator. From 1908 to 1909, he lived in Paris, where the new art movements influenced him. Dove's work never achieved popularity in his lifetime in spite of the support of photographer Alfred Stieglitz and art collector and patron Duncan Phillips. Today, Dove is recognized as a pioneer in modern American art. Charles C. Eldredge

Dove, Rita (1952-), an American poet, won the 1987 Pulitzer Prize for *Thomas and Beulah* (1986). Like many of her poems, this collection addresses aspects of Dove's African American heritage. It tells the moving story of her grandparents—their tragedies, struggles, and quiet love for one another. These poems richly evoke the history of African Americans' migration from the rural south to the urban north, and the new lives they found there. Dove's other poetry takes up a wide range of subjects, including stories of slaves and memories of her own childhood. Dove has also written poems about works of art and historical figures.

Dove's poems contain sharply drawn images that follow one another without obvious logical or narrative connections. But there is always an emotional pattern behind the images. Dove has a keen ear for the sounds of words, making her poems delightful to hear, even in the absence of traditional rhyme and meter.

Three volumes of Dove's poetry were collected in *Selected Poems* (1993). Her poems were also collected in *On the Bus with Rosa Parks* (1999). She has also written short stories, a novel, and a play. She served as the poet laureate of the United States from 1993 to 1995. Rita Frances Dove was born in Akron, Ohio. Roger Gilbert

Dover, Delaware (pop. 32,135; met. area pop. 126,697), is the state capital and the commercial center of a large rural area. Dover lies in central Delaware on the St. Jones River. The city's main industries include canning, food processing, and the manufacture of latex products. Agricultural products of the area include poultry, soybeans, corn, and potatoes. Delaware State University and Wesley College are in the city. Dover Air Force Base is near the city. Dover was founded in 1717 and became the capital of Delaware in 1777. It was incorporated as a town in 1829 and as a city in 1929. It has a council-manager government. Dover is the seat of Kent County. See **Delaware** (pictures; map). Michael J. Pelrine

Dover is an English town on the Strait of Dover. It is the chief town in the district of Dover, which has a population of 102,600. It is famous for its white cliffs, which border the strait. These cliffs are made of chalk. On a clear day, a person standing on the cliffs can see the city of Calais, France, 26 miles (42 kilometers) away. The ruins of Dover Castle overlook the town from one of the chalk cliffs. During World War II (1939-1945), Germany shelled and bombed the city. Dover is the main port of sea travel between England and France, and the city's port is a major source of local employment. An underwater railroad tunnel from a point near Dover to France opened in 1994 (see **Channel Tunnel**). See also **Citadel** (picture); **England** (picture). D. A. Pinder

Dover, Strait of, is a narrow channel connecting the English Channel and the North Sea. It separates England and France at their closest points. The shallow strait is about 21 miles (34 kilometers) wide and has an average depth of less than 100 feet (30 meters). Chalk cliffs rise high on either side of the strait. The ports of Dover, England, and Calais, France, are opposite each other on the Strait of Dover. The United Kingdom and France began building a railroad tunnel under the strait in 1987. The tunnel opened in 1994. Many athletes have set records by swimming across the English Channel, usually from Calais to Dover (see **English Channel**). Hugh D. Clout

WORLD BOOK map

The Strait of Dover lies between England and France.

© Joe & Carol McDonald, Animals/Animals

The mourning dove was named for the sad cooing sound made by the male. This North American bird is found from southeastern Alaska and southern Canada to Panama.

Dow, Herbert Henry (1866-1930), was an early leader in the United States chemical industry. In 1897, he founded the Dow Chemical Company. Through research and development, which Dow emphasized, the company has made a variety of products. It mass-produced industrial chemicals, led in developing carbon tetrachloride, introduced a cheap *phenol* (carbolic acid), and developed uses for bromine extracted from seawater (see **Bromine**; **Carbon tetrachloride**). Dow was born in Belleville, Ontario. John A. Heitmann

Dow Jones averages are statistics that show the price trends of stocks traded in the United States. Dow Jones & Company, a financial news publishing firm, computes the averages every few seconds of every business day.

There are three Dow Jones averages: (1) the Industrial Average, which tracks stock prices of 30 major firms; (2) the Transportation Average, which follows the stocks of 20 transportation companies; and (3) the Utility Average, which represents 15 utility companies. *The Wall Street Journal,* a newspaper owned by Dow Jones & Company,

reports the figures. Public investment strategy is often centered on these averages.

The Industrial Average is the one most often used by investors. It tracks *blue chip stocks,* which are issued by well-established firms. American financial journalist Charles H. Dow introduced the Industrial Average in 1896 as an average of the stock prices of 12 companies. The Transportation Average, formerly the Railroad Average, began in 1884. The Utility Average began in 1929.

In the beginning, the Dow Jones averages were computed by simply adding the prices of the stocks and dividing by the number of stocks. The averages soon became vulnerable to distortion, however, when some companies began *splitting* their stocks—that is, issuing two or more shares of stock for each existing share. Suppose, for example, that a stock was selling for $18. If the company *split it two for one* (issued two shares for each existing share), the price would drop to $9. The investor would lose nothing, because two shares of stock would still be worth $18. But the Dow Jones average, based on the price of a single share, would report an artificial decline in value.

To correct distortions due to stock splits and other events, Dow Jones & Company changed its way of computing the averages. Beginning in 1928, it started using a *flexible divisor.* Under this method, which continues today, the total of the stock prices is not simply divided by the number of stocks. Instead, it is divided by a number that can be changed to take into account stock splits and other changes. Critically reviewed by Dow Jones & Company

See also **Standard & Poor's indexes.**

Dower is a wife's right to a share of her deceased husband's *real property* (real estate). It is sometimes called the *widow's share.* Under English and American common law, the widow is entitled to one-third of her husband's property during her lifetime. The common law bars a husband from transferring ownership of his real property during his lifetime without his wife's consent. This protects the wife's dower right. A husband may also claim a share of his deceased wife's property. This right is called *estate by curtesy.*

Most states in the United States have passed legislation that substantially alters the common-law dower right, often increasing the share of the widow. Some states have *community property* laws, rather than the law of dower. These laws provide that a couple share ownership of property gained during their marriage. John W. Wade

See also **Common law; Community property.**

Dowland, John (1563-1626), was an English composer during the Renaissance. He was also considered one of the best lute players of his time. The lute is a stringed instrument with a pear-shaped body and is played like a guitar. Dowland composed many songs for voice accompanied by the lute. "Flow my tears," from his *Second Book of Airs* (1600), was one of the most famous pieces of its time. Dowland's beautiful songs are often on dark and melancholy subjects. He also wrote religious songs, difficult lute solos, and dances for lute and Renaissance bowed instruments called *viols.*

Dowland may have been born in London. He graduated from Oxford University and performed at the court of Elizabeth I. Dowland served various foreign rulers, notably the king of Denmark from 1598 to 1606, when he returned permanently to England. In 1612, he became court lutanist to King James I. Joscelyn Godwin

Down syndrome, *SIHN drohm,* formerly called *Mongolism,* is a disorder that is present at birth. It is characterized by mental retardation and such physical features as upward-slanting eyes; a flat nose; a small head; and short, stubby hands. In addition, the ears and teeth are small and abnormally shaped. Down syndrome may be accompanied by heart disorders, poor vision, and respiratory problems. The degree of mental retardation in children ranges from severe to mild.

Down syndrome is caused by an abnormality in the number of *chromosomes.* Chromosomes are the parts of a cell that contain tiny structures called *genes,* which determine hereditary traits. People with Down syndrome have 47 chromosomes instead of the normal 46, or 23 pairs. The extra chromosome occurs as a third chromosome with the pair designated as *chromosome 21.* Scientists use special tests to examine the chromosomes in an unborn baby and to determine whether the fetus has certain defects (see **Genetic counseling**).

Down syndrome appears in an average of 1 of every 1,000 births. It can occur in people of every nationality and all social and economic backgrounds. The risk of having a child with Down syndrome increases greatly after a woman reaches the age of 35.

Children with Down syndrome can be trained and can develop their full potential within the limits of their disability. Foster homes and various institutions care for individuals with severe mental retardation. Most experts recommend that children with less serious disabilities live at home. Studies show that, in general, children reared at home have a higher IQ and achieve more than those raised in institutions. Children who live at home can attend special classes in public schools. Many can be trained to do routine tasks and can learn simple skills. Special workshops offer jobs to adults with Down syndrome, and some adults work in regular industry.

Down syndrome was named after John Langdon Haydon Down, a British physician who first described the condition in 1866. It was once called Mongolism because the facial features of young patients seemed to resemble those of Asians. Anne Christake Cornwell

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Dowser. See **Divination.**

Doyle, Arthur Conan (1859-1930), a British writer, created Sherlock Holmes, the world's best-known detective. Millions of readers have followed Holmes's adventures and delighted in his ability to solve crimes by an amazing use of reason and observation. Doyle wrote a story in 1893 in which Holmes was killed. But public demand forced Doyle to bring Holmes back to life in another story. Critic Christopher Morley said of Holmes, "Perhaps no fiction character ever created has become so charmingly real to his readers."

Doyle was born in Edinburgh, Scotland. He began practicing medicine in 1882, but his practice was not a success. He started writing while waiting for the patients that never came. His early stories earned him little

money, but he won great success with his first Holmes novel, *A Study in Scarlet* (1887).

Brown Bros.

Arthur Conan Doyle

Holmes appeared in 56 short stories and three other novels—*The Sign of Four* (1890), *The Hound of the Baskervilles* (1902), and *The Valley of Fear* (1915). Doyle may have been the highest paid short-story writer of his time. He also wrote historical novels, romances, and plays. He eventually abandoned fiction to study and lecture on *spiritualism* (communication with spirits). For his efforts in support of the British cause during the Boer War (1899-1902), Doyle was knighted in 1902. He became known as Sir Arthur Conan Doyle. David Geherin

See also **Holmes, Sherlock.**

D'Oyly Carte, *DOY lee KAHRT,* **Richard** (1844-1901), an English theater manager, produced all but the first of the 14 operettas written by Sir William S. Gilbert and Sir Arthur S. Sullivan. D'Oyly Carte's production of their second work, *Trial by Jury* (1875), established the team as a success. D'Oyly Carte used the profits from his productions of Gilbert and Sullivan's early operettas to build the Savoy Theatre in London in 1881. Gilbert and Sullivan's last eight operettas had their premières at the Savoy. Their works became known as *Savoy operas,* and performers and other people associated with them became known as *Savoyards.* In the 1880's, D'Oyly Carte founded the D'Oyly Carte Opera Company to perform Gilbert and Sullivan operettas. In 1891, he opened the Royal English Opera House (now the Palace Theatre) to encourage native English opera. D'Oyly Carte was born on May 3, 1844, in London. See also **Gilbert and Sullivan.** J. P. Wearing

Drabble, Margaret (1939-), is an English novelist. She has become especially popular among women readers for realistic portrayals of middle-class women struggling with demands of careers, personal relationships, and other interests. Her best novels, particularly *The Needle's Eye* (1972), contain detailed and perceptive analyses of dilemmas women face in the modern world.

Drabble's early novels, such as *A Summer Bird-Cage* (1963) and *The Garrick Year* (1964), are almost autobiographical studies of conflicts young women experience in their careers, marriages, and family lives. Her later novels, such as *The Realms of Gold* (1975) and *The Ice Age* (1977), include a larger number of characters who represent a cross section of English society.

In later works, Drabble gave more emphasis to economic, political, and social concerns. In *The Middle Ground* (1980) and *The Radiant Way* (1987), she focuses on how social change influences her characters. *A Natural Curiosity* (1989) and *The Gates of Ivory* (1992), sequels to *The Radiant Way,* continue the social concern and characters of the earlier work. *The Peppered Moth* (2001) tells about several generations of an English family, focusing on a character based on Drabble's mother. Drabble has also written historical works, biographies, and literary criticism and was the editor of the fifth edition of *The Oxford Companion to English Literature* (1985). Drabble was born on June 5, 1939, in Sheffield. Jane Marcus

Drachma, *DRAK muh,* is a nickel-brass coin that was the monetary unit for Greece. It was phased out when Greece switched to the euro in 2002. The drachma was once made of silver. It was one of the standard coins of ancient Greece and was equal to six *obols.* R. G. Doty

WORLD BOOK photo by James Simek

The drachma was the monetary unit of Greece.

Draco, *DRAY koh,* was a Greek lawmaker who introduced the first written code of law in ancient Athens in 621 B.C. The code was designed to reduce discontent caused by the unfairness of the Athenian justice system. The system had been based on unwritten laws known only to a few aristocratic judges, who often favored the nobility. By putting laws into writing, Draco's code enabled people to find out for themselves what the laws were. Draco's code was said to be "written in blood" because it made almost all crimes punishable by death. Today, the word *Draconian* means *harsh* or *cruel.*

Before introduction of the code, punishment for murder was left to the victim's family, and bloody feuds were common. The code placed responsibility for upholding the law in the hands of the government. It helped Athens become one of the first city-states, or independent political units that consisted of a city and its surrounding territory. Donald Kagan

Dracula, *DRAK yuh luh,* a novel by the English author Bram Stoker, is the most famous vampire story of all time. The main character is a wicked nobleman, Count Dracula of Transylvania, a region of Romania. Dracula is a vampire—a corpse that returns to life at night, attacks innocent people, and sucks their blood.

In the novel, Dracula's search for new victims leads him to England. There, he pursues two young women, Lucy Westenra and Mina Murray. He, in turn, is hunted by Mina's fiancé, Jonathan Harker, and by Abraham Van Helsing, an authority on vampires. The two men finally destroy Dracula. *Dracula* was based on vampire legends that probably arose from hundreds of savage murders committed in the 1400's by Vlad Tepes, a prince from Walachia, a region south of Transylvania.

Stoker's novel, published in 1897, is probably best known as a motion picture. Film versions include *Nosferatu* (1922) and *Dracula* (1931). David Geherin

See also **Stoker, Bram; Vampire.**

Draft is a written order drawn by one party, directing a second party to pay a definite amount of money to a third party. Such a party may be an individual, a corpora-

tion, or a bank. Most drafts are used to finance business transactions when the buyer and seller are in different locations. A draft may also be drawn payable to the party that draws it.

A draft may read *pay at sight* or *on demand.* In such cases, the draft is like a check, and the payer must pay immediately upon accepting the draft. If a *time draft* is used, the payer accepts the draft, agreeing to pay it within a stated period. The draft, signed by the payer, becomes legally binding and is then called an *acceptance* or *note.*

A draft is the same as a *bill of exchange* except that the term *draft* usually means a transfer of money between parties in the same country. Bills of exchange are frequently used for the transfer of money abroad. A draft drawn on a bank is a *check.* Checks originate with the buyer, but trade drafts originate with the seller. Sellers of goods and services often use drafts to avoid the credit risk of open book accounts. Joanna H. Frodin

See also **Bill of exchange**; **Commercial paper**; **Negotiable instrument**; **Note.**

Draft, Military, also called *conscription* or *national service,* is a system of selecting men, and occasionally women, for required military service. A nation's needs for military personnel determine how long a conscript must serve and the branch of the armed forces in which he or she serves.

Governments have often conscripted men when they needed larger military forces than they felt they could get through voluntary enlistments. Many countries use a draft during wartime. Some nations also operate a draft in peacetime. Other countries have never had a draft.

Military drafts throughout history. The armies of ancient Greece and Rome conscripted men at times, though they generally relied on professional troops or hired foreign troops. In Europe during the Middle Ages, to bear arms was considered a privilege of the nobility. Ordinary men were not conscripted, but they could be called to military service in times of extreme emergency. Rulers often employed *mercenaries* (soldiers who offer their services for hire) to increase the size of their forces.

King Gustavus Adolphus of Sweden conscripted men to fight the Thirty Years' War (1618-1648). France began conscription during the French Revolution (1789-1799), and Napoleon I later drafted huge armies for his conquests. Conscription in the United States began in colonial times, when most colonies required all able-bodied men to serve in a local militia. Most colonies sent militia troops to fight in the Revolutionary War in America (1775-1783). In the 1800's, Prussia produced a large, skilled army by calling up small groups of conscripts for a year's training and then placing them in the reserves. During the American Civil War (1861-1865), both the Union and the Confederacy called up members of state militias to fight and also drafted other men for service.

Several of the countries involved in World War I (1914-1918) began conscripting troops at the outbreak of the war. These countries included Austria-Hungary, France, Germany, and Russia. The United Kingdom and the United States began conscripting men later during the war. Other countries called up civilians that they had earlier drafted and trained as reservists. During World War II (1939-1945), all the warring countries used mass conscription.

In the United States, the draft for World War II ended in 1946. But the government reinstated a draft from 1948 to 1972 because of its deep involvement in world affairs, the tensions created by the Cold War, and U.S. commitments in the Vietnam War (1957-1975).

Military drafts today. Today, modern methods of warfare have generally reduced the need for large military forces. Many countries, including the United States, have abandoned the draft and returned to all-volunteer armies. This system tends to produce armed forces with better-trained personnel who serve for longer periods. But its disadvantages include difficulty in attracting enough people when needed. In addition, some people believe that an all-volunteer force can become too independent from the general public. Many people think that military service should be an obligation of a country's citizenship. Also, some see the draft—and resulting lower military pay—as a way to reduce military spending.

Many of the countries of Latin America, Southeast Asia, the Middle East, and northern Europe still rely on a draft to supply or to supplement their armed forces. In some of these countries, drafted soldiers serve for only a short time, often less than a year, before returning to civilian life. Robert R. Mackey

See also **Army** (The rise of modern armies); **Canada, History of** (The conscription issue); **Selective Service System.**

Drafting. See **Mechanical drawing.**

Drag. See **Aerodynamics** (Drag); **Streamlining.**

Drag racing. See **Automobile racing** (Drag racing); **Hot rod.**

Drago, *DRAH goh,* **Luis María** (1859-1921), an Argentine statesman and jurist, supported the principle that became known as the *Drago Doctrine.* Drago was minister of foreign affairs in 1902, when the United Kingdom, Germany, and Italy aroused Latin America by blockading Venezuelan ports. Drago argued that no European country could use public debt as an excuse for armed intervention or for the occupation of American territory. The Hague Peace Conference of 1907 accepted his doctrine.

Drago was born in Buenos Aires. He studied law and became a judge of both the civil and criminal courts. The United Kingdom and the United States asked him to arbitrate the Atlantic fisheries dispute in 1909 and 1910. The Carnegie Endowment for International Peace invited him to visit the United States. It described Drago as the "most eminent exponent of intellectual culture in South America." Paul B. Goodwin, Jr.

Dragon is a legendary beast in the folklore of many European and Asian cultures. Legends describe dragons as large, lizardlike creatures that breathe fire and have a long, scaly tail. In Europe, dragons are traditionally portrayed as ferocious beasts that represent the evils fought by human beings. But in Asia, especially in China and Japan, the animals are generally considered friendly creatures that ensure good luck and wealth.

Many European legends tell how a hero slew a dragon. For example, Apollo, a god of the ancient Greeks and Romans, once killed a dragon called Python. Saint George, the patron saint of England, rescued a princess from a dragon by slaying the beast with a lance.

According to some medieval legends, dragons lived

Orsanmichele, Florence. SCALA/Art Resource

Saint George Slaying the Dragon is a marble sculpture created in the early 1400's by the Italian sculptor Donatello.

in wild, remote regions of the world. Dragons guarded treasures in their dens, and a person who killed one supposedly gained its wealth. The English epic hero Beowulf died in a fight with a treasure-guarding dragon.

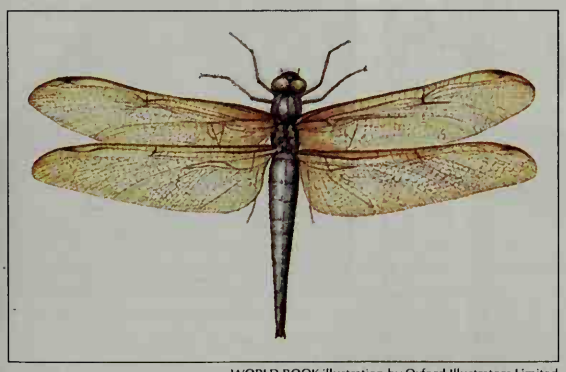
In China, the traditional New Year's Day parade includes a group of people who wind through the street wearing a large dragon costume. The dragon's image, according to an ancient Chinese belief, prevents evil spirits from spoiling the new year. Another traditional Chinese belief is that certain dragons have the power to control the rainfall needed for each year's harvest.

Carl Lindahl

See also Chen Rong; Fafnir.

Dragon, Komodo. See Komodo dragon.

Dragonfly is a beautiful flying insect. It has four large, fragile wings that look like fine gauze. The wings shimmer and gleam in the sunlight when the insect flies. The dragonfly's long, slender body may be red, green, or blue, with white, yellow, or black markings. Large compound eyes, which look like beads, cover most of the head. The dragonfly can see motionless objects almost 6 feet (1.8 meters) away, and moving objects two or three times that distance. The insect has six legs covered with spines. It can use its legs to perch on a limb, but the legs are not adapted for walking. As the dragonfly flies through the air, it holds its legs together to form a basket in which to capture insects. The dragonfly grabs hold of its prey with its legs or jaws, and may eat it while flying.



WORLD BOOK illustration by Oxford Illustrators Limited

A dragonfly has four large wings and can fly swiftly. It can attain speeds of up to 60 miles (97 kilometers) an hour.

Dragonflies have been known to fly 50 to 60 miles (80 to 97 kilometers) an hour. They fly so swiftly that they usually escape from birds or other animals. Some extinct species of dragonflies had wingspreads of 2 $\frac{1}{2}$ feet (76 centimeters).

Male and female dragonflies often fly together and sometimes mate while in flight. The female often deposits her eggs in water or places them inside the stem of a water plant. The *nymph* (young dragonfly) hatches within one to three weeks. It has a thick body, big head and mouth, and no wings. It has a folding lower lip, called a *mask*, which is half as long as its body. The lip has jawlike hooks at the end and can move out to capture victims. The nymph breathes by means of gills.

The dragonfly nymph remains in the water for one to five years. It eats insects and small water animals. Some large dragonfly nymphs feed on young fish. While developing into an adult dragonfly, the nymph *molts* (sheds its skin) about 12 times. For its final molt, the nymph leaves the water and climbs onto a reed or rock. It then sheds its skin for the last time and emerges as an adult that soon can fly. Adult dragonflies live for only a few weeks to a few months.

Dragonflies are sometimes called *devil's-darning-needles, snake doctors, snake feeders, horse stingers,* and *mule killers.* They help people by feeding on harmful insects such as mosquitoes. Small, graceful *damsel flies* look like dragonflies, but have more slender, fragile bodies.

Sandra J. Glover

Scientific classification. Dragonflies and damsel flies belong to the class Insecta. They make up the order Odonata.

See also **Insect** (illustration: Incomplete metamorphosis).

Drainage, in agriculture, is the removal of excess water that is on or beneath the surface of the soil. Most plants do not grow well in soil that is saturated with water. Usually, water drains naturally from the soil. The water runs off, evaporates, is absorbed by the soil, or used by plants. In areas that do not drain naturally, artificial drainage systems may be used to aid plant growth. Drainage systems are also used to make soil suitable for other purposes, including the construction of buildings and highways.

Excess water may collect on or in soil from rainfall, irrigation, or underground sources. Soils require drainage if they have water standing on their surface or if water fills the spaces between the soil particles. Soils also need to be drained if the area has a high *water table.* The water table is the topmost level of a zone of saturated soil. In soils that do not drain properly, the water table may be close to or at the surface. A high water table limits the growth of most plant roots or causes them to rot. A drainage system lowers the water table, allowing air to enter the soil so plants can grow normally.

In irrigated areas, drainage systems may serve another purpose. Most irrigation water contains salts. After plants use this water, the salts remain in the soil. If allowed to collect, salts can reduce or prevent plant growth. Drainage systems carry away or dissolve out these salts.

There are two main types of drainage systems—*surface drainage* and *subsurface drainage.* Both systems carry excess water to a suitable outlet, such as a pond or stream. A third system drains soil by means of wells and pumps. This system is usually too costly.

Surface drainage is used in areas that are flat, have much rainfall, and collect water rapidly. Surface drainage is also used to drain fine-textured soils, such as silts and clays, which do not absorb water quickly. Surface drainage systems may consist of shallow channels or deep ditches. These systems reduce the need for subsurface drainage, which costs more than surface drainage.

Shallow channels can be dug in random patterns along low areas where water runs naturally. Ditches may be used in large, flat areas. They may be dug to a depth of 3 to 6 feet (0.9 to 1.8 meters) in a parallel pattern. The ditches drain excess water from the surface or a high water table. However, the ditches obstruct the movement of human beings, machines, and animals. In addition, they take up farmland and may accumulate weeds.

Subsurface drainage lowers high water tables. A subsurface system may use a series of buried tubes, pipes, or tiles. Plastic tubes or clay pipes may have small holes through which water enters the system. Drainage tiles consist of 12-inch (30-centimeter) clay pieces that are placed end to end. Water enters through the spaces between tiles. Gravel may be placed around the tubes, pipes, or tiles to prevent soil from entering and plugging the system.

The tubes, pipes, or tiles measure 4 to 30 inches (10 to 75 centimeters) in diameter. They are buried 30 to 600 feet (9 to 180 meters) apart and 3 to 8 feet (0.9 to 2.4 meters) deep. The cost of laying the system increases with depth. However, the deeper the system is laid, the fewer pieces are needed. J. Neil Jednoralski

See also Irrigation (Providing artificial drainage).

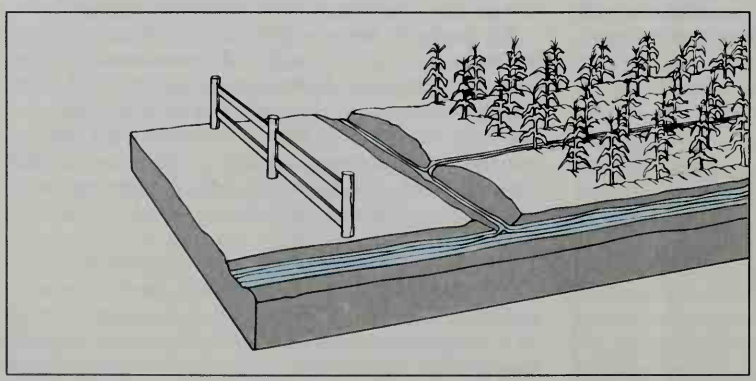
Drake is the male duck. See Duck.

Drake, Edwin Laurentine. See Petroleum (Beginnings of the oil industry).

Drake, Sir Francis (1543?-1596), an explorer and military commander, was the first Englishman to sail around the world. His naval warfare against the Spaniards, the chief rivals of the English, helped England become a major sea power.

Drake was the most famous of the sea captains who roved the oceans during the rule of Queen Elizabeth I. The queen encouraged the "sea dogs," as the captains were called, to raid Spanish shipping. She gave them money and ships for such voyages, and she shared in the treasure they brought back. Drake lived in the great age of piracy and became one of the most feared pirates of his time.

Drake had no formal education. However, he had great self-confidence and ambition. In battle, Drake was courageous, quick, and sometimes merciless. He treated his crew with kindness but demanded loyalty and respect from them.



WORLD BOOK illustrations by Bill and Judie Anderson

Drainage systems remove excess water on or beneath the surface of the soil. Surface drainage systems, *left,* consist of a series of channels or ditches. Subsurface drainage systems use a series of tubes, pipes, or tiles buried underground. Drainage tubing, *right,* has small holes through which water enters. The water is carried to a pond or other suitable outlet. Subsurface systems cost more than surface systems.

Early life. Drake was born near Plymouth in Devonshire. In 1549, he moved with his family to the county of Kent, where his father became a chaplain in naval shipyards on the coast. Francis was apprenticed to the master of a ship that sailed to ports on the English Channel and in the mouth of the River Thames.

From 1566 to 1569, Drake sailed on two slave-trading voyages organized by his cousin, Sir John Hawkins, a famous sea dog. Hawkins obtained slaves in Africa and sold them to West Indian plantation owners. These voyages brought protests from both Portugal and Spain. Portugal did not want English competition in the slave trade, and Spain objected to English ships sailing in Caribbean waters. The slave-trading voyages gave Drake valuable sailing experience.

In 1567, Drake commanded the *Judith* on the second of the expeditions organized by Hawkins. On the return trip, the ships stopped at the Mexican port of San Juan de Ulúa, near Veracruz. A fleet of Spanish ships approached the harbor, pretending to be friendly. But the Spaniards attacked the English, killing many sailors and sinking several vessels. Only the *Judith* and Hawkins's ship, the *Minion,* escaped. Drake returned to England hating the Spaniards and vowing revenge.

From 1570 to 1572, Drake took part in looting missions to the West Indies. In 1572, he seized several Spanish ships off the coast of Panama. He landed on the coast and captured the port of Nombre de Dios, near Colón. Drake then looted the town and ambushed a mule train carrying Peruvian silver across the Isthmus of Panama.

Voyage around the world. Drake's most famous voyage began on Dec. 13, 1577. He and more than 160 men sailed from Plymouth in the *Pelican,* the *Elizabeth,* and the *Marigold.* Two other ships, the *Swan* and the *Benedict* (also known as the *Christopher*), carried supplies. The original goals of the voyage are not clear, nor is Queen Elizabeth's role in planning the voyage. But Drake hoped to explore the possibilities of trade and colonial settlement in the Pacific Ocean and to find the western outlet of the Northwest Passage (see **Northwest Passage**). Drake also may have intended to search for an undiscovered continent that was believed to lie in the South Pacific. He probably planned to loot Spanish ships and colonies along the Pacific coast of South America.

After leaving São Tiago in the Cape Verde Islands, Drake's expedition met two Portuguese ships. Drake captured one of the vessels and gave its command to a friend, Thomas Doughty. The ships sailed south along the Atlantic coast of South America and ran into violent storms. The expedition then stopped at San Julián for supplies. There, Drake had Doughty beheaded because he suspected him of planning a mutiny.

Before leaving San Julián, Drake destroyed the supply ships and the captured Portuguese ship because they were in poor condition, and he did not think they could complete the voyage. The three remaining ships sailed through the Strait of Magellan. Shortly afterward, violent storms blew the ships far to the south. The storms wrecked the *Marigold* and sent the *Elizabeth* off course, forcing it to return to England. The *Pelican,* which Drake had renamed the *Golden Hind,* explored the southernmost islands of South America before heading north along the continent's Pacific coast. The Spaniards had left their coastal ports unguarded because until then, only Spanish ships had sailed the Pacific. After raiding several Spanish settlements, Drake captured a Spanish ship, the *Cacafuego,* and stole its cargo of gold, silver, and jewels.

Loaded with treasure, the *Golden Hind* sailed north along the Pacific coast of North America, perhaps as far as 48° north latitude. Drake then turned south. He repaired his ship near what is now San Francisco and named the area New Albion. He claimed the land for England. Drake had planned to return to England through the Strait of Magellan, not to sail around the world. But he feared an attack by the Spaniards if he sailed south again. So he decided to sail home by way of the Pacific and Indian oceans.

Drake stopped for water at the Philippine Islands and for spices at the Molucca Islands. He also visited Sulawesi (Celebes) and Java. After crossing the Indian Ocean, Drake sailed around the Cape of Good Hope. Drake reached Plymouth on Sept. 26, 1580. He had been gone almost three years, and the voyage made him a national hero. Drake's voyage was the second voyage around the world. The first had been made from 1519 to 1522 by an expedition under the command of the Portuguese explorer Ferdinand Magellan.

Drake's voyage increased British interest in the Pacific Ocean and led to many trading ventures in eastern Asia. It broadened English knowledge about the world and paved the way for later exploration. Drake's raids on Spanish possessions angered King Philip II of Spain, and he demanded that Drake be punished. Elizabeth re-

Oil painting by an unknown artist; National Maritime Museum, Greenwich, England

Sir Francis Drake, a daring English seaman and pirate, helped England become a mighty sea power. Queen Elizabeth I knighted Drake in 1581 after he had sailed around the world.

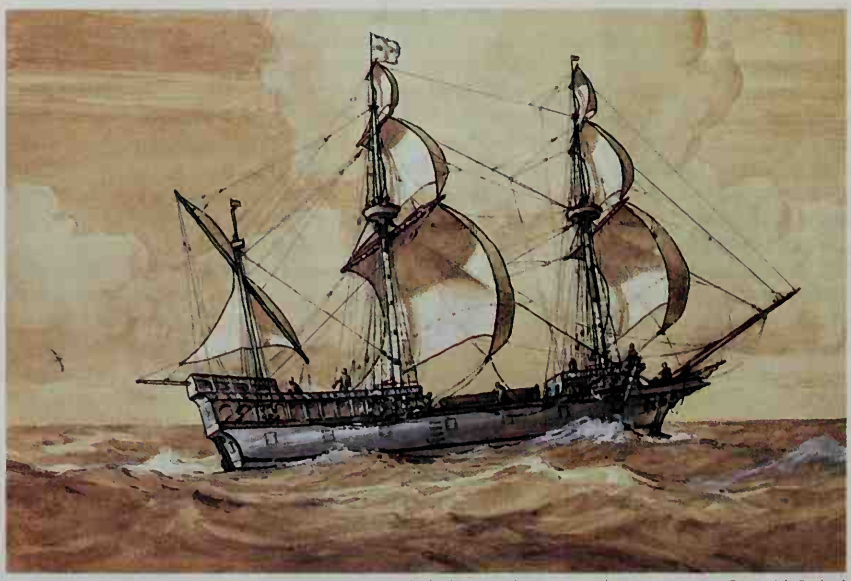
sponded in 1581 by making Drake a knight.

From 1580 to 1585, Drake lived at Buckland Abbey, his country home near Plymouth. He bought the home with his share of the wealth from the voyage. In 1581 and 1582, Drake served as mayor of Plymouth. In 1584 and 1585, he represented the town of Bossiney in the House of Commons.

Expeditions against Spain. In May 1585, King Philip ordered an embargo on English goods in Spain and on English ships in Spanish ports. His action angered Elizabeth. In September, she put Drake in command of a fleet of 25 ships and 2,000 men. He left that fall with orders to capture Spanish treasure ships in the West Indies.

On his way, Drake looted the Spanish port of Vigo and burned São Tiago. After landing on the island of Hispaniola, Drake's men burned Santo Domingo. They later occupied the town of Cartagena for six weeks and held it for ransom. On the return voyage, Drake looted and burned St. Augustine. He then sailed north to an English colony on Roanoke Island, in what is now North Carolina, and took some colonists back to England.

Meanwhile, Philip had begun to gather Spain's warships into a fleet called the *Invincible Armada*. The Spaniards gave their fleet this name because they thought it could not be defeated. Philip planned a great attack on England, but Elizabeth learned of his intention. The queen sent Drake to the Spanish port of Cádiz,



Water color by Gregory Robinson; National Maritime Museum, Greenwich, England

The *Golden Hind* was Sir Francis Drake's ship during his voyage around the world from 1577 to 1580. It was about 100 feet (30 meters) long and had 18 guns. Approximately 50 men finished the famous voyage with Drake.

Drake's voyage around the world, 1577-1580

This map shows the route Drake followed on his voyage around the world. After passing the Strait of Magellan, Drake raided Spanish ships along the western coast of South America. The voyage made Drake the first Englishman to sail around the world.

WORLD BOOK map

where his force sank about 30 ships and seized a great amount of supplies.

Yet, Drake could not prevent the Armada from sailing in May 1588. He proposed a plan to attack the Armada along the coast of Portugal, but the plan was not approved in time. The queen appointed Drake vice admiral of the English fleet.

In the summer of 1588, in the English Channel, the English and Spanish fleets fought one of history's greatest naval battles. Drake commanded a large group of warships from his ship, the *Revenge*. He played an important part in the Battle of Gravelines, in which the English sank or captured many Spanish ships. The surviving ships of the Armada fled into the North Sea, hoping to find a port in Ireland. But storms wrecked many of the ships, and the Irish killed several Spaniards who landed.

Later life. In 1589, Drake led a fleet in a raid on Lisbon, which was then a Spanish port. He seized many merchant vessels at Lisbon but failed to capture the city or carry out other parts of Elizabeth's instructions. Thousands of English sailors died on the voyage, and Elizabeth called it a failure.

Drake fell out of the queen's favor and received no commands for almost six years. Drake retired to Buckland Abbey and, in 1593, he represented Plymouth in the House of Commons.

Drake's last voyage took place in 1595, when he and Sir John Hawkins again sailed to the West Indies. Hawkins died as the fleet reached the islands. Drake went on and destroyed several towns. He captured Nombre de Dios but could not seize Panama City. While still off the coast of Panama, he died of dysentery. His crew buried him at sea. Helen Delpar

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Drakensberg is the most important range of mountains in South Africa. The range is over 620 miles (1,000 kilometers) long. It extends from the Stormberg Mountains in the Eastern Cape Province, through KwaZulu-Natal to the Wolkberg Mountains in eastern Mpumalanga. For location, see **South Africa** (terrain map). In most places, the mountain range forms part of the Great Escarpment, a semicircular series of cliffs separating the high inland plateau from the lower coastal belt. The highest peak in the range is Thaba Ntlenyana, which rises 11,425 feet (3,482 meters) in Lesotho. South Africa's highest point, the 11,072-foot (3,375-meter) Champagne Castle, is also located in the Drakensberg.

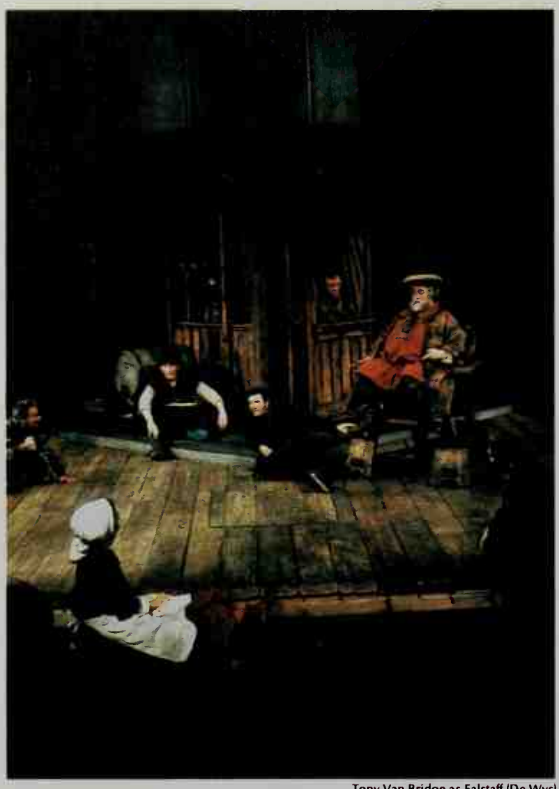
The mountains act as South Africa's main watershed, separating the rivers that flow into the Atlantic Ocean from those that flow into the Indian Ocean. Several of the country's major rivers originate in the Drakensberg. The peak Mont Aux Sources gives rise to the Tugela, Orange, and Elands rivers. The Tugela River plunges through a deep gorge in the Drakensberg and forms a series of five falls known as the Tugela Falls. The falls have a total height of 2,014 feet (614 meters) and are the highest in southern Africa. The highest of the five falls has a drop of 597 feet (182 meters).

The mountains originated about 150 million years ago when volcanic lava cooled and solidified, forming basalt. The Drakensberg were a main area of settlement of the San people. Magnificent San paintings can still be seen in several caves. The Zulu and Sotho peoples called the range Ukhahlamba, which means "a barrier of pointed spears." The Dutch settlers saw the peaks as the "home of dragons" or "dragon mountains," which is the origin of the name Drakensberg.

Dram. See **Apothecaries' weight**.

© Graham Keats

The Drakensberg is South Africa's main watershed. The mountains separate the rivers that flow into the Atlantic Ocean from those that flow into the Indian Ocean.



Tony Van Bridge as Falstaff (De Wys)

Falstaff in Shakespeare's *Henry IV,* Part 1

William Hutt as Tartuffe, Stratford Festival Theatre

Tartuffe in Molière's *Tartuffe*

Dustin Hoffman as Willy Loman (Inge Morath, Magnum)

Willy Loman in Arthur Miller's *Death of a Salesman*

Drama

Drama is an art form that tells a story through the speech and actions of the characters in the story. Most drama is performed by actors who impersonate the characters before an audience in a theater.

Although drama is a form of literature, it differs from other literary forms in the way it is presented. For example, a novel also tells a story involving characters. But a novel tells its story through a combination of dialogue and narrative, and is complete on the printed page. Most drama achieves its greatest effect when it is performed. Some critics believe that a written script is not really a play until it has been acted before an audience.

Drama probably gets most of its effectiveness from its ability to give order and clarity to human experience. The basic elements of drama—feelings, desires, conflicts, and reconciliations—are the major ingredients of human experience. In real life, these emotional experiences often seem to be a jumble of unrelated impressions. In drama, however, the playwright can organize these experiences into understandable patterns. The audience sees the material of real life presented in meaningful form—with the unimportant omitted and the significant emphasized.

No one knows exactly how or when drama began, but nearly every civilization has had some form of it. Drama may have developed from ancient religious ceremonies that were performed to win favor from the gods. In these ceremonies, priests often impersonated supernatural beings or animals, and sometimes imitated such actions as hunting. Stories grew up around some rites and lasted after the rites themselves had died out. These myths may have formed the basis of drama.

Another theory suggests that drama originated in choral hymns of praise sung at the tomb of a dead hero. At some point, a speaker separated from the chorus and began to act out deeds in the hero's life. This acted part gradually became more elaborate, and the role of the chorus diminished. Eventually, the stories were performed as plays, their origins forgotten.

According to a third theory, drama grew out of a natural love of storytelling. Stories told around campfires re-created victories in the hunt or in battle, or the feats of dead heroes. These stories developed into dramatic retellings of the events.

This article describes the history of drama. For a discussion of modern theater arts, see the *World Book* article on **Theater.**

Julius Novick, the contributor of this article, is Professor of Literature at the State University of New York College at Purchase and theater critic for The New York Observer *and* The Village Voice. *He is the author of* Beyond Broadway: The Quest for Permanent Theatres.

Forms of drama

Among the many forms of Western drama are (1) tragedy, (2) serious drama, (3) melodrama, and (4) comedy. Many plays combine forms. Modern dramatists often disregard these categories and create new forms.

Tragedy maintains a mood that emphasizes the play's serious intention, though there may be moments of comic relief. Such plays feature a *tragic hero,* an exceptional yet flawed individual who is brought to disaster and usually death. The hero's fate raises questions about the meaning of existence, the nature of fate, morality, and social or psychological relationships. Aristotle identified the emotional effect of tragedy as the *"catharsis* [emotional release] of pity and fear."

Serious drama, which developed out of tragedy, became established in the 1800's. It shares the serious tone and often the serious purpose of tragedy and, like tragedy, it concentrates on unhappy events. But serious drama can end happily, and its heroes are less imposing and more ordinary than the tragic hero. Serious drama is sometimes viewed as tragedy's modern successor.

Melodrama involves a villain who initiates actions that threaten characters with whom the audience is sympathetic. Its situations are extreme and often violent, though endings are frequently happy. Melodrama portrays a world in which good and evil are clearly distinguished. As a result, almost all melodramas have a sharply defined, oversimplified moral conflict.

Comedy tries to evoke laughter, often by exposing the pretensions of fools and rascals. Comedy usually ends happily. But even in the midst of laughter, comedy can raise surprisingly serious questions. Comedy can be both critical and playful, and it may arouse various responses. For example, *satiric comedy* tries to arouse scorn, while *romantic comedy* tries to arouse joy.

Orion Press

A kabuki play in Japan

Farce is sometimes considered a distinct dramatic form, but it is essentially a type of comedy. Farce uses ridiculous situations and broad physical clowning for its humorous effects.

The structure of drama

Aristotle, a Greek philosopher who lived in the 300's B.C., wrote the earliest surviving and most influential essay on drama, called *Poetics.* In it, he identified the parts of a tragedy as (1) plot, (2) character, (3) thought, (4) diction, (5) music, and (6) spectacle. These six elements are fundamental to all types of drama, not just tragedy. In a well-written play, all of the elements combine to form a unified, coherent, and purposeful sequence of incidents.

Plot is a term sometimes used to mean a summary of a play's story. More properly, it means the overall structure of the play. In this sense, it is the most important element of drama. The beginning of a play includes *exposition,* which gives the audience information about earlier events, the present situation, or the characters. Early in most plays, the author focuses on a question or a potential conflict. The author brings out this question or conflict through an *inciting incident* which sets the action in motion. The inciting incident makes the audience aware of a *major dramatic question,* the thread that holds the events of the play together.

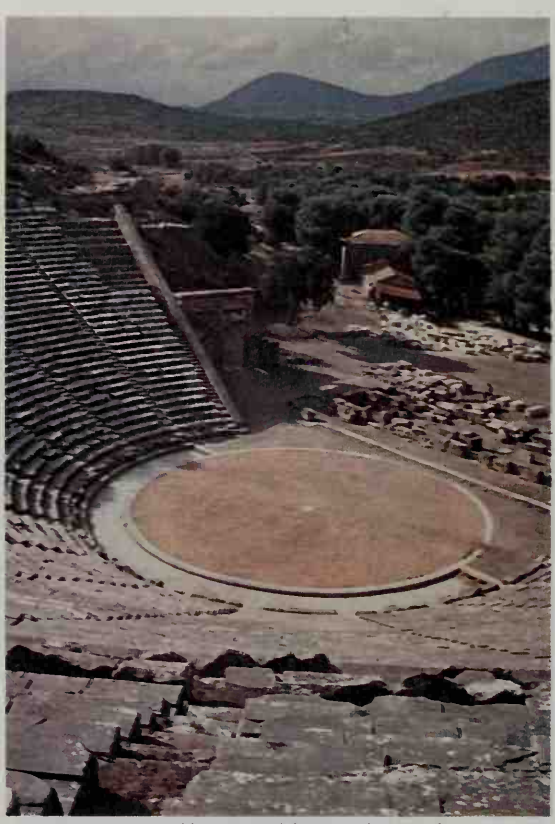
Most of the play involves a series of *complications*—discoveries and decisions that change the course of action. The complication leads to a *crisis,* a turning point when previously concealed information is at least partly revealed and the major dramatic question may be answered. The final part of the play, often called the *resolution,* extends from the crisis to the final curtain. It pulls together the various strands of action and brings the situation to a new balance, thus satisfying the expectations of the audience. Writers of modern drama often ignore these traditional aspects of plot.

Character is the principal material from which a plot is created. Incidents develop mainly through the speech and behavior of dramatic characters. The characters must be shaped to fit the needs of the plot, or the plot must be shaped to fit the needs of the characters.

Thought. Every play, even the most light-hearted comedy, involves thought in its broadest sense. In dramatic structure, thought includes the ideas and emotions implied by the words of all the characters. Thought also includes the overall meaning of the play, sometimes called the *theme.* Not all plays explore significant ideas. But every play makes some comment on human experience, either through direct statement or, more commonly, by implication.

Other parts of drama. *Diction,* or *dialogue,* is the use of language to create thought, character, and incident. *Music* involves either musical accompaniment or, more commonly today, the arranged pattern of sound that makes up human speech. *Spectacle* deals with the visual aspects of a play, especially the physical actions of the characters. Spectacle also refers to scenery, costumes, makeup, stage lighting, and props.

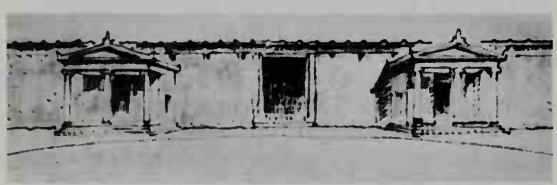
Greek drama

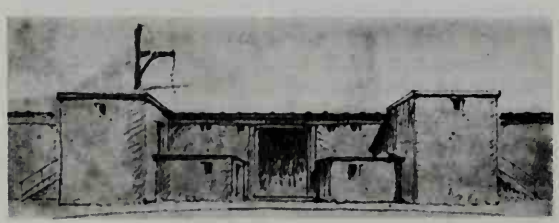


Ruins of the ancient Greek theater at Epidaurus; David Seymour, Magnum

Ancient Greek theaters were outdoor amphitheaters that seated thousands of spectators for annual contests in acting, choral singing, and writing comedy and tragedy. Scholars are not sure what the stages looked like. The drawings below show some possible reconstructions of the stage house of the Theater of Dionysus.

Illustration from *Antike Grieschische Theaterbauten* by Robert Fiechter, courtesy University of Chicago Library





Drama was born in ancient Greece. Much of our knowledge of Greek theater comes from archaeological studies and historical writings of the time. By the 600's B.C., the Greeks were giving choral performances of dancing and singing at festivals honoring Dionysus, their god of wine and fertility. Later, they held drama contests to honor Dionysus. The earliest record of Greek drama dates from about 534 B.C., when a contest for tragedy was established in Athens. Thespis, who was the winner of the first competition, became the earliest known actor and dramatist. The word *thespian* comes from his name.

The most important period of ancient Greek drama was the 400's B.C. Tragedies were performed as part of an important yearly religious and civic celebration called the *City Dionysia.* This festival, which lasted several days, offered hotly contested prizes for the best tragedy, comedy, acting, and choral singing.

The Greeks staged performances in the Theater of Dionysus, on the slope below the Acropolis in Athens. The theater seated about 14,000 people. It consisted of rows of stadiumlike seats that curved about halfway around a circular acting area called the *orchestra.* Beyond the circle and facing the audience was the *skene* (stage house), originally used as a dressing area and later as a background for the action. This structure eventually developed into a long building with side wings called *paraskenia* projecting toward the audience. The skene probably had three doors. The action may have taken place on a raised platform, or perhaps entirely in the orchestra. See **Europe** (picture: Ancient Greek drama).

Tragedy. Greek tragedy, perhaps because it originally was associated with religious celebrations, was solemn, poetic, and philosophic. Nearly all the surviving tragedies were based on myths. Typically, the main character was an admirable, but not perfect, person confronted by a difficult moral choice. This character's struggle against hostile forces ended in defeat and, in most Greek tragedies, his or her death.

Greek tragedies consisted of a series of dramatic episodes separated by choral odes (see **Ode**). The episodes were performed by a few actors, never more than three on stage at one time, during the 400's B.C. A chorus danced and sang and chanted the odes to musical accompaniment.

The actors wore masks to indicate the nature of the characters they played. Men played women's roles, and the same actor appeared in several parts. The acting style, by modern standards, was probably far from realistic. The poetic language and the idealized characters suggest that Greek acting was dignified and formal. The dramatist usually staged his own plays. A wealthy citizen called the *choregus* provided the money to train and costume the chorus.

Of the hundreds of Greek tragedies written, fewer than 35 survive. All but one were written by three dramatists—Aeschylus, Sophocles, and Euripides.

Aeschylus, the earliest of the three, won 13 contests for tragedy. His plays are noted for their lofty tone and majestic language. He was the master of the *trilogy,* a dramatic form consisting of three tragedies that focus on different phases of the same story. His *Oresteia,* the only surviving Greek trilogy, tells how Clytemnestra killed her husband, Agamemnon, and was then killed by

Roman copy of a Greek marble bas-relief of 100's or 200's B.C., courtesy Vatican Museums (Raymond Schoder, S.J.)

Menander was the most popular Greek playwright of his time. This bas-relief shows him with masks worn in comedies. The woman at the right may represent Thalia, the goddess of comedy.

their son Orestes. This trilogy traces the development of the idea of justice from primitive vengeance to enlightened, impersonal justice administered by the state. This development is portrayed in a powerful story of murder, revenge, remorse, and divine mercy. The chorus is important in Aeschylus' plays.

Sophocles is the playwright whose work served as the primary model for Aristotle's writing on tragedy. Sophocles seems today the most typical of the Greek tragic playwrights. His plays have much of Aeschylus' philosophic concern, but his characters are more fully drawn and his plots are better constructed. He was also more skillful in building climaxes and developing episodes. Aeschylus used only two characters on stage at a time until Sophocles introduced a third actor. This technique increased the dramatic complexity of Greek drama. Sophocles also reduced the importance of the chorus. His most famous play, *Oedipus Rex,* is a masterpiece of suspenseful storytelling and perhaps the greatest Greek tragedy.

Euripides was not widely appreciated in his own day, but his plays later became extremely popular. Euripides is often praised for his realism. His treatment of traditional gods and myths shows considerable doubt about religion, and he questioned moral standards of his time. Euripides showed his interest in psychology in his many understanding portraits of women. His *Medea* describes how a mother kills her children to gain revenge against their father.

Euripides used a chorus, but did not always blend it well with the episodes of his tragedies. He is sometimes criticized for his dramatic structure. Many of his plays begin with a prologue summarizing past events and end with the appearance of a god who resolves a seemingly impossible situation.

Satyr plays. Each playwright who competed in the contests at the City Dionysia had to present three tragedies and then a satyr play. The satyr play, a short comic parody of a Greek myth, served as a kind of humorous afterpiece to the three tragedies. It may be even older than tragedy. The satyr play used a chorus performing as *satyrs* (mythical creatures that were half human and half animal). The actors and chorus in the tragedies also appeared in the satyr play.

Only one complete satyr play still exists—Euripides' *Cyclops.* It is a parody of Odysseus' encounter with the monster Cyclops. The satyr play was a regular part of the Athenian theater during the 400's B.C. But the form disappeared when Greek drama declined after the 200's B.C.

Old Comedy. Greek playwrights did not mix tragedy and comedy in the same play. Greek Old Comedy, as the comic plays of the 400's are called, was outspoken and bawdy. The word *comedy* comes from the Greek word *komoidia,* which means *merrymaking.*

In the first scene of a typical Old Comedy, a character suggests the adoption of a *happy idea.* For example, in the comedy *Lysistrata* by Aristophanes, the women of Athens figure out a way to stop their men from going to war. After a debate called an *agon,* the proposal, sometimes greatly changed, is adopted. The rest of the play shows the humorous results. Most of these plays end with a *komos* (an exit to feasting and merrymaking).

The only surviving examples of Old Comedy are by Aristophanes. He combined social and political satire with fantasy, robust farce, obscenity, personal abuse, and beautiful lyric poetry. Aristophanes was a conservative who objected to the social, moral, and political changes occurring in Athenian society. In each of his plays, he ridiculed and criticized some aspect of the communal life of his day.

New Comedy. Tragedy declined after 400 B.C., but comedy remained vigorous. Comedy changed so drastically, however, that most comedies written after 338 B.C. are called New Comedy. In spite of its popularity, only numerous fragments and a single play have survived. The play is *The Grouch* by Menander, the most popular playwright of his time. Most New Comedy dealt with the domestic affairs of middle-class Athenians. Private intrigues replaced the political and social satire and fantasy of Old Comedy. In New Comedy, most plots depended on concealed identities, coincidences, and recognitions. The chorus provided little more than interludes between episodes.

Roman drama

After the 200's B.C., Greek drama declined and leadership in the art began to pass to Rome. Today, Greek drama is much more highly regarded than Roman drama, which for the most part imitated Greek models. Roman drama is important chiefly because it influenced later playwrights, particularly during the Renaissance. William Shakespeare and the other dramatists of his day knew Greek drama almost entirely through Latin imitations of it.

In Rome, tragedy was less popular than comedy, short farces, pantomime, or such nondramatic spectacles as battles between gladiators. Roman theaters were adaptations of Greek theaters. The government supported theatrical performances as part of the many Roman religious festivals, but wealthy citizens financed some performances. Admission to theatrical performances was free and audiences were unruly in the brawling, holiday atmosphere.

The Roman stage was about 100 feet (30 meters) long and was about 5 feet (1.5 meters) above the level of the orchestra. The back wall represented a *façade* (building front) and probably had three openings. In comedies, these openings were treated as entrances to houses, and the stage became a street. Scholars disagree on whether the back wall was flat or three-dimensional.

Tragedy was introduced in Rome by Livius Andronicus in 240 B.C. But the dramatic works of only one Roman tragedian, Lucius Annaeus Seneca, still exist. Seneca's plays probably were never performed during his lifetime. His nine surviving plays were based on Greek originals. These plays are not admired today. However, they were extremely influential during the Renaissance.

Later western dramatists borrowed a number of techniques from Seneca. These techniques included the five-act form; the use of elaborate, flowery language; the theme of revenge; the use of magic rites and ghosts; and the device of the *confidant,* a trusted companion in whom the leading character confides.

Comedy. The only surviving Roman comedies are the works of Plautus and Terence. All their plays were adaptations of Greek New Comedy. Typical plots revolved around misunderstandings. These misunderstandings frequently were based on mistaken identity, free-spending sons deceiving their fathers, and humorous intrigues invented by clever slaves. Plautus and Terence eliminated the chorus from their plays, but they added many songs and much musical accompaniment. Plautus' humor was robust, and his plays were filled with farcical comic action. Terence avoided the broad comedy and exaggerated characters of Plautus' plays. Terence's comedies were more sentimental and more sophisticated and his humor more thoughtful. His six plays had a strong influence on later comic playwrights, especially Molière in France in the 1600's.

Marble relief sculpture showing a Roman adaptation of Greek New Comedy; National Museum, Naples, Italy (SCALA/Art Resource)

Roman comedy was usually performed on a stage that represented a public street. The back wall had openings through which the actors entered and exited. Most Roman comedies included musical accompaniment and many songs. Actors wore comic masks.

Minor forms of drama were popular in Rome, but no examples of these forms exist today. The *mime,* a short and usually comic play, was often satiric and obscene. In the *pantomime,* a single dancer silently acted out stories to the accompaniment of choral narration and orchestra music.

The Roman theater gradually declined after the empire replaced the republic in 27 B.C. The minor dramatic forms and spectacles became more popular than regular comedy and tragedy. Many of these performances were sensational and indecent, and offended the early Christians. In the A.D. 400's, actors were excommunicated. The rising power of the church, combined with invasions by barbarian tribes, brought an end to the Roman theater. The last known performances in ancient Rome took place in A.D. 533.

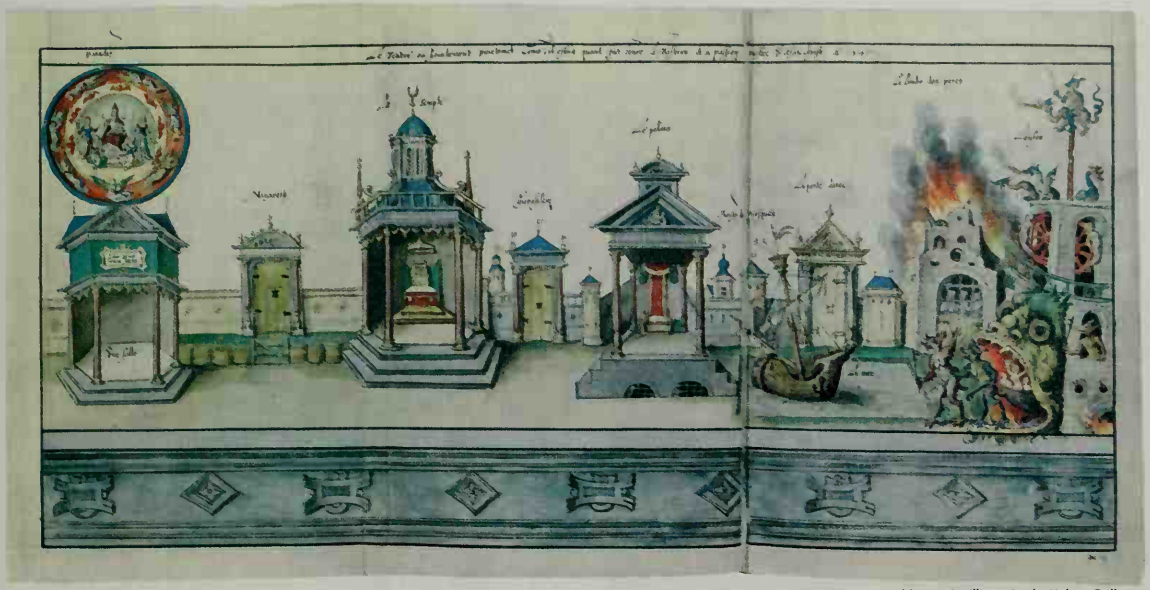
Medieval drama

Although state-supported drama ended in the A.D. 500's, scattered performances by traveling mimes and troubadours probably continued throughout the Middle Ages. The plays of Plautus, Terence, and Seneca were preserved by religious orders which studied them not as plays but as models of Latin style.

Medieval drama flourished from the 900's to the 1500's, and became increasingly diverse. It was gradually suppressed, however, because of the religious strife associated with the Reformation. By 1600, religious drama had almost disappeared in every European country except Spain.

Liturgical drama. The rebirth of drama began in the 900's with brief playlets acted by priests as part of the *liturgy* (worship service) of the church. The Resurrection was the first event to receive dramatic treatment. A large body of plays also grew up around the Christmas story, and a smaller number around other Biblical events. In the church, the plays were performed in Latin by priests and choirboys.

Mystery plays. Beginning in the 1200's, plays were moved outdoors. Plays written after this time are often called *mystery plays.* These plays, which were written in verse, taught Christian doctrine by presenting Biblical



Manuscript illustration by Hubert Cailleau, courtesy Bibliothèque Nationale, Paris

Mansion stages were popular in medieval Europe. They consisted of separate settings on a long platform. The actors moved from one setting to another, following the action of the play.

Illustration from *A Dissertation on the Pageants or Dramatic Mysteries Anciently Performed at Coventry* by Thomas Sharp, courtesy Oscar G. Brockett

Pageant wagons were traveling stages used to present drama in medieval England. Audiences stood in the street or saw the plays from nearby houses. The actors were townspeople.

characters as if they lived in medieval times. Many mystery plays were rich with comedy.

During the 1300's, the performance of mystery plays was taken over by such *secular* (nonreligious) organizations as trade guilds. The *vernacular* (local language) replaced Latin. The short plays had been staged throughout the year. But by the 1300's, they were often given as a group called a *cycle*. A cycle portrayed the entire Christian story of the relationship between God and human beings, from the creation of the world to the final judgment. It included an account of the life, death, and Resurrection of Jesus Christ. Cycles usually were performed during the summer.

Cycles of mystery plays from four English towns—Chester, Lincoln, Wakefield, and York—have been preserved. All date from the 1300's. Plays from France, Italy, Spain, and elsewhere have also survived.

In England, the setting for each play was mounted on a *pageant wagon*. This wagon was drawn through a city to various places where audiences gathered. Because of the limited space, the actors probably performed on a platform beside the wagon. The audience usually stood in the street or watched the performance from nearby houses. The actors were townspeople, and most of them belonged to the trade guilds that financed and produced the plays.

In various cities on the European continent, several *mansions* (miniature settings) were erected on a long platform. The actors moved from one of these settings to another, according to the action of the play. See **Mystery play.**

Miracle plays and morality plays were also popular during the Middle Ages. Miracle plays dramatized events from the lives of saints or the Virgin Mary. The action in most of these plays reached a climax in a miracle performed by the saint. Morality plays used allegorical characters to teach moral lessons. These dramas

grew from fairly simple religious plays into secular entertainments performed by professional acting companies. See **Miracle play; Morality play.**

Farces and interludes. Purely secular drama achieved its greatest development in two short forms of drama—the farce and the interlude. Farces were almost entirely comic, and many were based on folk tales. Interludes originally were entertaining skits, probably acted between courses during banquets or at other events. The interlude was especially associated with the coming of professional actors who became regular parts of many noble households.

Italian Renaissance drama

Even before the development of the theater in England and Spain, the Renaissance had begun to transform Italian drama. A new interest in ancient Greece and Rome extended to the drama, and classical plays were studied for the first time as drama, not just as literature. Italian critics of the 1500's wrote essays based on Aristotle's *Poetics* and Horace's *Art of Poetry.* From these essays grew a movement in the arts known later as *neoclassicism.*

The centers of Italian theatrical activity were the royal courts and the academies, where authors wrote plays that imitated classical drama. These plays were produced in small private theaters for the aristocracy. Most of the actors were courtiers, and most performances were a part of court festivities.

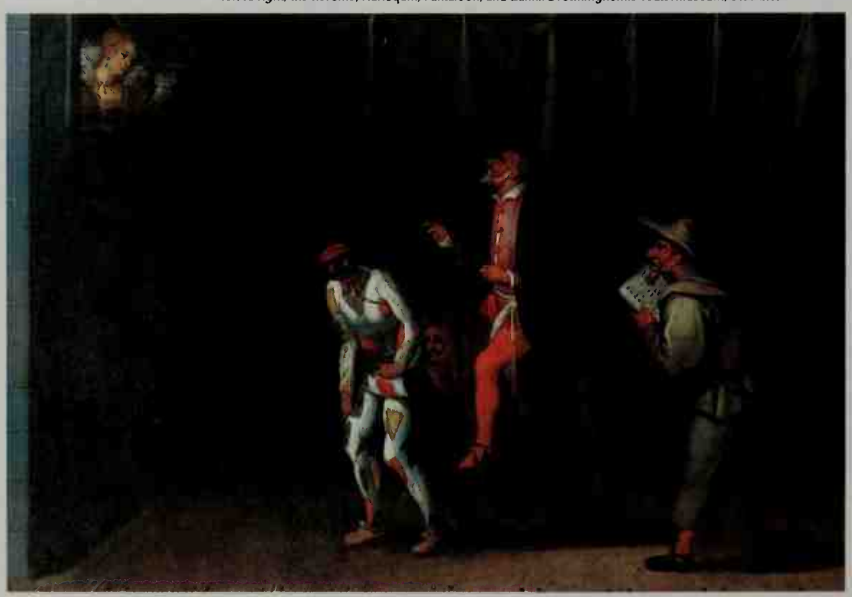
There were three types of plays—comedy, tragedy, and *pastoral.* Pastoral drama dealt with love stories about woodland goddesses and shepherds in idealized rural settings. Few Italian Renaissance plays had much real artistic value. But they are important historically because they departed from the shapelessness of medieval drama and moved toward greater control of the plot. Ludovico Ariosto was the first important comic writer. His comedies *Cassaria* (1508) and *I Suppositi* (1509) are considered the beginning of Italian drama. *La Mandragola* (about 1520), a comedy by the statesman and writer Niccolò Machiavelli, is still admired and performed today. The first important tragedy was *Sofonisba* (1515), by Giangiorgio Trissino, who followed the Greeks rather than Seneca.

Intermezzi and operas. To satisfy the Italian love of spectacle, the *intermezzo,* a new form, developed from the court entertainments. The intermezzi were performed between acts of regular plays. They drew flattering parallels between mythological figures and people of the day, and provided opportunities for imaginative costumes and scenery. After 1600, the intermezzi were absorbed into opera, which originated in the 1590's from attempts to reproduce Greek tragedy. By 1650, opera was Italy's favorite dramatic form.

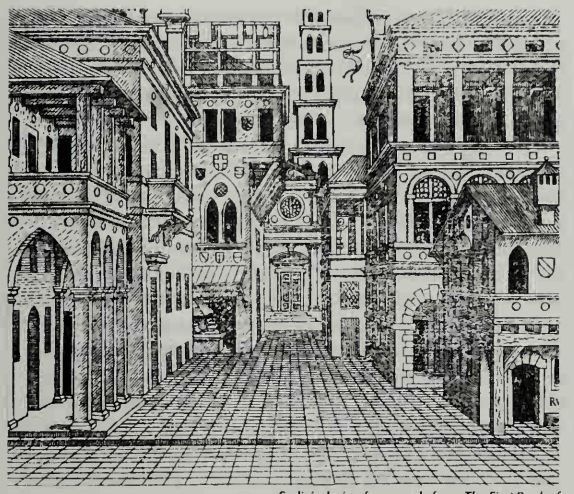
The Italian stage. More important than the plays was the new type of theater developed in Italian courts and academies. Italian scenic designers were influenced by two traditions—the Roman façade theaters and the newly acquired knowledge of perspective painting. In 1545, Sebastiano Serlio published the first Italian essay on staging. He summarized contemporary methods of adapting the Roman theater for use indoors. Serlio's designs show semicircular seating in a rectangular hall and a wide, shallow stage. Behind the shallow stage was a *raked* (tilted) stage on which painted sets created a perspective setting. Serlio's three stage designs—for comedy, tragedy, and pastoral dramas—were widely imitated.

The Roman façade was recreated in the Teatro Olimpico, Italy's first important permanent theater, which opened in 1585. A *perspective alley* showing a view down a city street was placed behind each of seven

Pantaloon Serenading His Mistress, (about 1580), an oil painting on wood panel by an unknown artist showing, *left to right,* the heroine, Harlequin, Pantaloon, and Zanni. Drottningholms Teatermuseum, Stockholm



Commedia dell' arte was a loosely constructed form of comedy that dominated Italian drama from the 1500's through the 1700's. A stock group of characters appeared in all commedia plays.



Serlio's design for comedy from *The First Book of Architecture*, courtesy Newberry Library, Chicago

Scenic designs by Sebastiano Serlio popularized perspective settings in Renaissance drama. His designs for comedy, tragedy, and satire were based on the classical Roman stage.

openings in the façade. A more significant development of the façade appeared in the Teatro Farnese, built in 1618. This theater had the first permanent *proscenium* arch, a kind of large frame that enclosed the action on stage. It was especially suited for perspective settings. In 1637, the first public opera house opened in Venice. There, earlier developments helped create the proscenium stage that dominated theater until the 1900's.

Commedia dell' arte (pronounced *kawm ME dyah del LAHR tay*) was the name given to boisterous Italian plays in which the actors *improvised* (made up) the dialogue as they went along. Commedia was a truly popular form in Italian, as opposed to the literary drama of the court and academies. Commedia was performed by professional actors who worked as easily on simple platforms in a market square as they did on elaborate court stages.

The commedia script consisted of a *scenario* (outline of the basic plot). Characters included such basic types as Harlequin the clown and Pantaloon the old man. The same actor always played the same role. Most of the lively, farcical plots dealt with love affairs, but the main interest lay in the comic characters. We do not know how commedia originated, but by 1575 the companies that performed it had become extremely popular in Italy. Commedia soon was appearing throughout Europe. It remained a vigorous force in drama until the mid-1600's, and continued to be performed until the end of the 1700's. Commedia had an important influence on much of the comedy written during the 1600's.

Elizabethan, Jacobean, and Caroline drama

The Reformation directly affected the history of drama by promoting the use of national languages rather than Latin. The use of these languages led to the development of national drama. The first such drama to reach a high level of excellence appeared in England between 1580 and 1642. Elizabethan drama was written mainly during the last half of the reign of Queen Elizabeth I, from about 1580 to 1603. Jacobean drama was written during the reign of King James I (1603-1625). William Shakespeare, the greatest dramatist of the age, bridged the Elizabethan and Jacobean periods, but he generally is considered an Elizabethan playwright. Caroline drama was written in the reign of King Charles I (1625-1649).

Elizabethan theaters. The first public theater in England, called The Theatre, was built near London in 1576. By 1642, there had been at least nine others in and around London, including the Globe, Rose, and Fortune.

All Elizabethan public theaters had the same basic design. A large unroofed area called the *yard* was enclosed by a three-storied, gallery-type structure that was round, square, or octagonal. A large, elevated platform stage projected into the yard and served as the theater's principal acting area. The audience stood in the yard or sat in the galleries, watching the play from three sides.

At the rear of the platform stood a two- or three-story façade. On the stage level, the façade had two doors that served as the principal entrances. Another acting area on the second level was used to represent balconies, walls, or other high places. Some theaters had a façade with a third level where the musicians sat. The specific place of the dramatic action was indicated primarily through descriptive passages in the play's dialogue. A few pieces of scenery were used. This theater design was ideal for Elizabethan plays, which moved at a rapid pace and had many scenes.

Performances began in the early afternoon and lasted until just before dusk. Women never appeared on the professional stage. Boys played women's roles, and some acting companies consisted entirely of boys. All classes of society attended the theater, and refreshments were sold during performances. The audience watched in a boisterous, holiday mood.

Elizabethan playwrights. Elizabethan plays developed from the interludes performed by wandering actors, and the classically inspired plays of schools and universities. These two traditions merged in the 1580's when a new group of playwrights, many of them university-educated, began writing for professional actors of the public theater.

Thomas Kyd is important in the history of drama because he brought classical influence to popular drama. Kyd wrote the most popular play of the 1500's, *The Spanish Tragedy* (1580's). This play established the fashion for tragedy in the theater. It moved freely in place and time, as did medieval drama. But *The Spanish Tragedy* also showed the influence of Seneca in its use of a ghost, the revenge theme, the chorus, the lofty poetic style, and the division of the play into five acts. Most of all, Kyd demonstrated how to construct a clear, absorbing story. He wrote *The Spanish Tragedy* in blank verse and established this poetic form as the style for English tragedy (see **Blank verse**). *The Spanish Tragedy* may seem crude today. However, the play was a remarkable advance over earlier drama and had great influence on later drama.

Detail from a painting (about 1597) by an unknown artist of a wedding masque during a banquet at the house of Sir Henry Unton, National Portrait Gallery, London

Masques were elaborate, colorful spectacles that combined music, dancing, vivid costumes, and symbolic drama. English masques were popular with royalty and nobility.

Christopher Marlowe perfected blank verse in English tragedy. Marlowe wrote a series of tragedies that centered on a strong *protagonist* (main character). Marlowe's work was filled with sensationalism and cruelty, but it included splendid poetry and scenes of sweeping passion.

John Lyly wrote primarily for companies of boy actors that specialized in performing before aristocratic audiences. Most of Lyly's plays were pastoral comedies. He mixed classical mythology with English subjects, and wrote in a refined, artificial style.

Robert Greene also wrote pastoral and romantic comedies. His *Friar Bacon and Friar Bungay* (about 1589) and *James IV* (about 1591) combined love stories and rural adventures with historical incidents. Greene's heroines are noted for their cleverness and charm.

Thus, by 1590, several dramatists had bridged the gap between the learned and popular audiences. Their blending of classical and medieval devices with absorbing stories established the foundations upon which Shakespeare built. William Shakespeare, like other writers of his time, borrowed from fiction, histories, myths, and earlier plays. Shakespeare contributed little that was entirely new, but he developed the dramatic techniques of earlier playwrights. His dramatic poetry is unequaled, and he had a genius for probing character, producing emotion, and relating human experience to broad philosophical issues.

Ben Jonson's comedies are sometimes called *corrective* because he tried to improve human behavior by ridiculing foolishness and vice. He popularized the *comedy of humours.* According to a Renaissance medical concept, everyone had four *humours* (fluids) in his or her body. Good health depended on a proper balance among them. An excess of one humour might dominate a person's disposition. An excess of bile, for example, supposedly made a person melancholy. Jonson also wrote two tragedies on classical subjects, and many elaborate spectacles called *masques.*

Several other playwrights bridged the Elizabethan and Jacobean periods besides Shakespeare and Jonson. They included George Chapman, Thomas Dekker, Thomas Heywood, and John Marston.

Jacobean and Caroline drama. About 1610, English drama began to change significantly. The *tragicomedy,* a serious play with a happy ending, increased in popularity. Many plots were artificially arranged and contained sensational, rather than genuinely tragic, elements. The obsession of much Jacobean and Caroline tragedy with violence, dishonesty, and horror has appalled many critics. But these plays have also been greatly admired for their magnificent poetry, their dramatic power, and their unflinching view of human nature and the human condition.

Important Jacobean playwrights included Francis Beaumont, John Fletcher, Thomas Middleton, Cyril Tourneur, and John Webster. Philip Massinger and John Ford were among the important Caroline playwrights.

After Charles I was deposed in the 1640's and the Puritans gained control of Parliament, theatrical performances were prohibited. The Puritan government closed the theaters in 1642, ending the richest and most varied era of English drama.

The Golden Age of Spanish drama

The late 1500's brought a burst of theatrical activity in Spain as well as in England. The period between the mid-1500's and late 1600's was so productive that it is called the Golden Age of Spanish drama.

During the Middle Ages, religious drama developed only in northeastern Spain. The rest of the country was occupied by the Moors. After the Moors were driven from the country in the late 1400's, Spanish rulers began to re-Christianize the country. Drama became an important means of religious teaching. Religious drama, perhaps because of church control, grew in importance in Spain while being banned in other countries during the Reformation. Until the 1550's, Spanish religious plays resembled those of other European nations. After 1550, the religious plays of Spain assumed various traits of their own.

Religious plays in Spain were called *autos sacramentales.* They combined features of the cycle play and the morality play. Human and supernatural characters were mingled with such symbolic figures as Sin, Grace, and Pleasure. Dramatists took stories from secular as well as religious sources, and adapted them to uphold church teachings. In Madrid, trade guilds staged the plays until the city council took over the job in the 1550's. The council engaged Spain's finest dramatists to write plays and hired professional companies to perform them. The public and religious stages closely resembled each other after 1550, and the same dramatists wrote for both.

Production of the plays varied from community to community, but the staging in Madrid was typical. The autos sacramentales were performed on *carros* (two-storied wagons) that resembled the pageant wagons of the English cycle plays. Carros carrying scenery were drawn through the streets to various points where audiences gathered. A second wagon served as a stage when placed in front of the carro. The second wagons eventually became permanent acting areas at various places, and the carros were drawn up to them. The autos were performed by professionals, but they retained their religious content and their close association with the church. They were performed annually during the Feast of Corpus Christi.

In addition to the autos, the actors performed short farces in the form of interludes and dances. These grew in importance, and gradually the secular elements began to dominate the performances. In 1765, church authorities forbade autos because of their content and the carnival spirit of farce and dancing.

Secular drama. The first permanent theater in Spain opened in Madrid in 1579. Spanish theaters generally resembled Elizabethan theaters in design.

Lope de Rueda, a dramatist, actor, and producer, established the professional theater in Spain during the mid-1500's. However, the professional Spanish theater actually did not flourish until after 1580. The two greatest playwrights of the Golden Age of Spanish drama were Lope de Vega and Pedro Calderón de la Barca.

Illustration by Juan Comba from *El Corral de la Pacheca* by Ricardo Sepúlveda, courtesy University of Chicago Library

Carros, the Spanish traveling stages, brought religious drama to town audiences during the annual Feast of Corpus Christi.

Lope de Vega may have written as many as 1,800 plays. More than 400 surviving plays are attributed to him. Lope took subjects for his plays from the Bible, the lives of the saints, mythology, history, romances, and other sources. He was inventive and skillful, but his plays lack the depth of Shakespeare's. Like Shakespeare, he often used song and dance and mixed the comic with the serious. Lope influenced almost all future Spanish drama.

Calderón wrote many kinds of plays, but is best known for works exploring religious and philosophical ideas. Most of his works were autos written for the Corpus Christi festivals of Madrid. After Calderón's death in 1681, Spanish drama declined rapidly and never fully recovered its early vitality.

French neoclassical drama

The French theater had its roots in the medieval religious plays produced by guilds. The most important of these amateur groups, the Confrérie de la Passion, established a permanent theater in Paris in the early 1400's. It eventually received a royal monopoly, making it the city's only play-producing organization.

During the late 1500's and 1600's, the Confrérie's theater, called the Hôtel de Bourgogne, was rented to visiting professional companies. The first of these groups to establish itself was Les Comédiens du Roi, sometime after 1598. Alexandre Hardy, the most popular dramatist of the early 1600's, wrote many plays for this company. Hardy mostly wrote loosely constructed tragicomedies filled with adventures of chivalry.

The French theater changed significantly after the neoclassic theories were imported from Italy. In France, these theories took firmer root and were followed more rigidly than elsewhere. The basic beliefs of neoclassicism can be summarized in four parts. (1) Only two types of drama, tragedy and comedy, were legitimate forms, and tragic and comic elements should not be mixed. (2) Drama should be written to teach a moral lesson by presenting the lesson in a pleasant form. (3) Characters should be universal types rather than eccentric individuals. This principle became known as the doctrine of *decorum.* (4) The unities of time, place, and action should be observed. This rule usually meant that a plot should cover no more than 24 hours, take place in a single locality, and deal with a single action.

Neoclassical playwrights. Although neoclassical ideas were accepted among educated French people in the late 1500's, they made little impression in public theaters until the 1630's. The playwright most closely associated with the change to neoclassic drama in France was Pierre Corneille. His play *The Cid* set off a stormy dispute that ended with the triumph of neoclassicism. *The Cid* is a tragicomedy based on a Spanish story. It follows many neoclassical rules, but violates the doctrine

of decorum because the heroine marries her father's murderer. In later plays, Corneille observed the neoclassic rules and helped establish neoclassicism as the standard for French drama. The distinguishing characteristic of Corneille's drama is the hero of unyielding will. The hero gains steadily in power, but his character does not become more complex. Corneille wrote in a form of verse called Alexandrine, which became standard for French neoclassic drama.

The plays of Jean Racine marked the peak of French neoclassic tragedy. His first dramas in the 1660's established his reputation, and he soon surpassed Corneille. Racine used neoclassical rules to concentrate and intensify the dramatic power of his stories. His tragedies contained little outward action. Their drama came from internal conflicts centering on a single fully developed personality. This character usually wants to act ethically, but is prevented by other forces—often by conflicting desires. Racine created simple plots, but he revealed his characters with remarkable truth.

Molière raised French comedy to a level comparable with that of French tragedy. He also was the finest comic actor of his age, and a theater manager and a director. Molière borrowed freely from many sources, including Roman comedy, medieval farce, and Spanish and Italian stories. His most famous plays were comedies that centered around such humorous eccentrics as misers. The ridiculous excesses of the protagonists were exposed by characters of "good sense." Molière's comedies offered much biting social and moral criticism, but were amusing and good-natured. He has achieved wider and more lasting appeal than Corneille or Racine.

By about 1690, the three major French dramatists were either dead or had given up writing. Most of their successors merely repeated the old formulas, and French drama declined.

European drama: 1660-1800

England. In 1660, the Restoration ended the Puritan government. Charles II returned to the throne. Once again the theater became legal in England. But the English theater had lost the broad popular appeal it had enjoyed in Shakespeare's day. It became the pastime of a narrow circle of courtiers. Only gradually did it again become popular with the middle classes.

Soon after the theaters reopened in 1660, new playhouses in the Italian style were built in London. These theaters had a large *apron* (the part of the stage in front of the proscenium arch). Permanent doors opened onto the apron. The auditorium had tiered galleries with some private boxes. Cheaper seats were in a roughly U-shaped flat area called the *pit*. Until 1762, spectators often sat on the stage itself.

Settings in the English theater closely resembled those used in Italy, with scenes painted in perspective. Because of the neoclassic demand for universal themes, most settings were generalized—a palace or a garden, for example. During the later 1700's, settings began to show specific places.

Actresses first appeared regularly on the English stage in the 1660's, and male actors soon stopped playing women's roles. Actors became increasingly important during the 1700's, and audiences often went to see outstanding performers rather than a particular play. Actors apparently based their style on real life, but their acting was undoubtedly more exaggerated than today's audiences would approve. In the 1740's, David Garrick brought greater realism to English acting.

The Restoration period is known especially for the *comedy of manners* and the *heroic drama*. The comedy of manners was the form most identified with the Restoration. It *satirized* (poked fun at) upper-class society in witty prose. Some of these satires tolerated immorality, but the ideal behind them was self-knowledge. Characters in the comedy of manners were ridiculed for deceiving themselves or trying to deceive others. The most common characters included the old woman trying to appear young, and the jealous old man married to a young wife. The ideal characters were worldly, intelligent, and undeceived.

The comedy of manners originated largely in the plays of George Etherege. The form was perfected in the dramas of William Congreve, whose *The Way of the World* (1700) is often called the finest example of the form. In the works of William Wycherley, the tone was coarser and the humor more robust.

English comedy enjoyed a period of extreme liberty during the reign of Charles II. But Puritan elements reappeared in the early 1700's as the merchant class grew more powerful. Middle-class disapproval of the comic tone was reflected in the change from the mocking Restoration plays to the more sentimental comedies of

David Garrick and Mrs. Pritchard in *Macbeth*, detail from a painting (about 1770) by Johann Zoffany; Garrick Club, London

David Garrick was the leading English actor of his day. Garrick's realistic style of acting had a great influence on the English theater.

School of Drama Library, Yale University

The School for Scandal by Richard Brinsley Sheridan is one of the greatest English comedies of the 1700's. This print shows a scene from the play at the famous Drury Lane Theatre in London in 1778.

George Farquhar. Farquhar put emphasis on emotion and good-hearted behavior.

The heroic play flourished from about 1660 to 1680. It was written in rhymed couplets and dealt with the conflict between love and honor. These plays featured elaborate rhetoric, many shifts in plot, and violent action. Such dramas seem absurd today, but they were popular in their time.

A more vital strain of tragedy developed alongside heroic drama. These tragedies were written in blank verse that imitated Shakespeare's. Notable examples were John Dryden's *All for Love* (1677), which reshaped the story of Antony and Cleopatra according to neoclassical rules, and Thomas Otway's *Venice Preserv'd* (1682).

The term *sentimental* is often applied to most drama of the 1700's. It indicates an overemphasis on arousing sympathy for the misfortunes of others. Plots dealt with the ordeals of characters with whom the audience sympathized. The humorous portions of plays featured such minor characters as servants. Today, the characters seem too noble and the situations too artificial to be convincing. But audiences of the 1700's liked them, believing that emotional displays were spiritually uplifting.

Sentimental comedy had its first full expression in *The Conscious Lovers* (1722) by Sir Richard Steele. In the 1770's, when this type of comedy dominated the English stage, two dramatists tried to reform public taste with comedies that avoided excessive sentimentality. Oliver Goldsmith attempted to reestablish what he called *laughing comedy* in the tradition of Ben Jonson. Richard Brinsley Sheridan's plays have the satire of Restoration comedy, but lack its questionable moral tone.

Domestic tragedy substituted middle-class characters for the kings and nobles of earlier tragedy. It is an ancestor of serious drama. Domestic tragedy showed the horrifying results of yielding to sin, while sentimental comedy showed the rewards of resisting sin. George Lillo's *The London Merchant* (1731) popularized domestic tragedy. This drama became a model for playwrights in France and Germany as well as England.

Several minor dramatic forms also developed. The *ballad opera* was a prose comedy with lyrics sung to popular tunes. The most famous one was John Gay's *The Beggar's Opera* (1728). The *burlesque* was a parody of well-known dramas or literary practices. The *pantomime* combined dance, music, acting without dialogue, and elaborate scenery and special effects.

France. By the end of the 1600's, France had become the cultural center of Europe. The standard for European drama was set by the neoclassic tragedies of Corneille and Racine and the comedies of Molière. The effort to obey the rules of neoclassicism tended to freeze dramatic invention during the 1700's. Voltaire was the only notable French tragic dramatist. The first important French writer of domestic tragedy was Denis Diderot. His plays enjoyed little popularity during his lifetime. However, his proposed reforms in staging, acting, and playwriting—all designed for greater realism—greatly influenced dramatists of the 1800's.

For most of the 1700's, the French government permitted only one theatrical company, the Comédie-Française, to produce regular comedy and tragedy. Minor forms, including comic opera, short plays, and burlesques, were staged by the Comédie-Italienne, an Italian group, and at Paris fairs.

Pierre Marivaux wrote comedies in a sophisticated style that had some sentimental touches but were primarily revelations of human psychology. Sentimental comedy appeared in the works of Pierre de La Chaussée. His play *The False Antipathy* (1733) established the popularity of *comédie larmoyante* (tearful comedy). True comedy in the form of brilliant social satire appeared in the plays of Pierre Beaumarchais.

Italy. During the 1700's, commedia dell'arte underwent changes in form. Carlo Goldoni was the greatest Italian dramatist of the century. He departed from the commedia style by creating several fully written plays in the mid-1700's that gained great popularity. During this time, Carlo Gozzi opposed Goldoni's changes in commedia, and attempted reforms of his own by writing

imaginative fantasies with some improvised scenes. Commedia dell'arte declined in popularity, and by the end of the 1700's, was no longer a significant form. The only important Italian tragic dramatist of the 1700's was Vittorio Alfieri.

Germany. A crude type of drama developed in various German states during the 1500's and 1600's. German theater had a low reputation until about 1725. At that time, the actress-manager Caroline Neuber and the dramatist Johann Gottsched made serious efforts to reform both playwriting and play production. Their work marked a turning point in German theater.

The dramatist and critic Gotthold Ephraim Lessing also made important contributions. His plays and his influential critical work *The Hamburg Dramaturgy* turned attention from French neoclassicism to English dramatic models. By the end of the 1700's, the German theater had been revolutionized. All major German states supported theaters modeled on the Comédie-Française, and German playwrights won recognition outside Germany. The neoclassical ideal was giving way to the romantic movement.

Asian drama

Drama in Asia developed independently of European drama. Not until the 1800's did Western playwrights generally become aware of Oriental drama and begin to borrow from its rich heritage.

India. Indian drama is one of the oldest in the world. Its exact origins are uncertain, but sometime between 200 B.C. and A.D. 200, the wise man Bharata wrote the *Natyasastra,* an essay which established traditions of dance, drama, makeup, costume, and acting.

By the mid-A.D. 300's, flourishing drama in the Sanskrit language had developed. In technique, Sanskrit plays resembled epic poems. Each play was organized around one of nine *rasas* (moods). The goal was to produce harmony, so authors avoided clashing moods and all plays ended happily. The most important of the surviving plays are *The Little Clay Cart* (probably A.D. 300's) and *Shakuntala* by Kalidasa (late 300's or early 400's).

China. The drama of China probably originated in ancient ceremonies performed in song, dance, and mime by priests at Buddhist shrines. Professional storytellers became common by the A.D. 700's, but not until the 1200's did performances become truly dramatic.

The first formal Chinese drama appeared during the Yuan dynasty (1279-1368). Since the 1800's, *Peking opera* (also called *Beijing opera*) has been the major form. The plays of the Peking opera are based on traditional stories, history, mythology, folklore, and popular romances. The play is merely an outline for a performance. Performers often make changes in the script.

The Chinese stage is simple, permitting rapid changes of location. These changes are indicated by speech, actions, or symbolic props. A whip, for example, indicates that a performer is on horseback. Musicians, and assistants who help the performers with their costumes and props, remain on stage during the performance. But by tradition they are considered invisible. The performer is the heart of Chinese theater. Richly and colorfully costumed, the performer moves, sings, and speaks according to rigid conventions. Each type of role has a definite vocal tone and pitch, and delivery follows fixed rhythmic patterns.

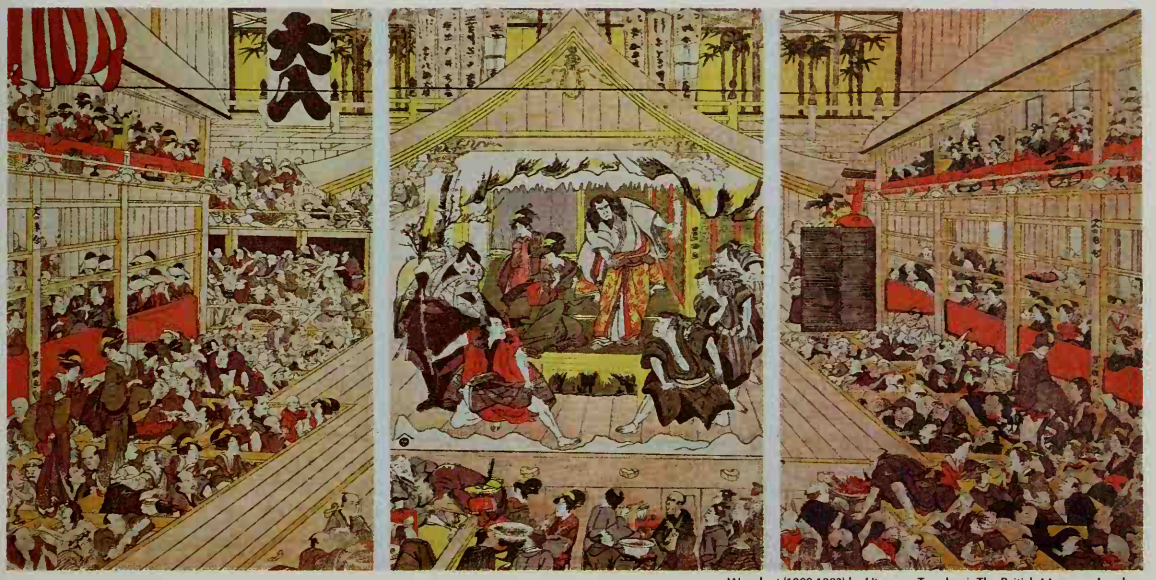
Japan. The *no* plays are the oldest of the three traditional forms of Japanese drama. They developed during the 1300's from dances performed at religious shrines. The no theater reached its present form in the 1600's, and it has remained practically unchanged since then.

No plays are poetic treatments of history and legend, influenced by the religious beliefs of Buddhism and

Edward B. Harper, University of Washington, Seattle

Scene from *The White Serpent;* Prof. Josephine Huang Hung, National Taiwan University, Taipei, Taiwan

Indian and Chinese drama emphasize national legends, myths, and history. Indian folk theater, *left,* dramatizes stories from Indian epics and sacred Hindu writings. Peking opera, *right,* is the leading dramatic tradition of China. Peking opera is noted for its richly costumed performers.



Woodcut (1800-1803) by Utagawa Toyokuni, The British Museum, London

Japanese kabuki plays, *above,* are violent and melodramatic. These plays, traditionally performed by male casts, dramatize historical or legendary events.

Shintoism. Many of these plays are shorter than Western one-act plays, and they may seem undramatic. Like ancient Greek tragedy, a no drama is accompanied by music, dance, and choral speaking, and the actors playing women and demons wear masks. The no performance is probably the most carefully controlled in the world. Every detail of the traditional stage, every movement of the hands and feet, every vocal intonation, and every detail of costume and makeup follows a rule.

Japanese *doll* or *puppet* theater enjoyed great popularity in the 1600's and 1700's. Today, only one theatrical company performs these plays. Like the no plays, the puppet dramas originally were religious. The puppets stand 3 to 4 feet (0.9 to 1.2 meters) high and look realistic, with flexible joints and movable eyes, mouth, and eyebrows. The puppet handlers work quietly on the stage in view of the audience. A narrator recites the story to music and expresses each puppet's emotions.

The *kabuki* play is the most popular traditional form in Japan today, and the most sensitive to changing times. It is also the least pure of the three traditional forms, having borrowed freely from other types of theater. Kabuki, the last of the forms to develop, appeared about 1600. It competed with the puppet theater for popularity during the late 1700's and also took over many puppet theater plays and techniques.

The earliest kabuki were performed by a single female dancer. An all-male cast later became traditional. Although kabuki borrowed much from the no drama, it differs greatly from the formality of the no plays. Kabuki theater is violently melodramatic. It features colorful costumes and makeup, spectacular scenery, and a lively and exaggerated acting style. See **Japan** (The arts [Theater; picture]).

Romanticism

Many elements made up romanticism, a European literary movement of the late 1700's and early 1800's. The most important was a growing distrust of reason and a new belief that people should be guided by their feelings and emotions. The romantics tended to rebel against traditional social and political institutions. Romantic playwrights rebelled against the rules of neoclassical tragedy, taking Shakespeare as their model. Variety and richness became the standard for judging drama, replacing the unity and simplicity admired by the classicists. See **Romanticism.**

By 1800, a productive romantic movement had become established in Germany. Two important dramatists of the period, Johann Wolfgang von Goethe and Friedrich Schiller, wrote plays in the romantic style, but both denied being romantics. In many ways, Goethe's *Faust* showed the romantic outlook in the protagonist's unending search for fulfillment. Many of Schiller's plays dramatized moments of crisis in history.

After Germany's defeat by Napoleon's armies in 1806, some Germans became increasingly interested in their national past and less hopeful about human nature. This skeptical attitude appeared in the work of two of the best German dramatists of the day, Heinrich von Kleist and Georg Büchner.

The intentions of French romantics were clearly established with the publication of Victor Hugo's preface to his play *Cromwell* in 1827. Romanticism triumphed in the French theater with the production of Hugo's *Hernani* in 1830. *Hernani* revolved around the conflict between love and honor, and was filled with exciting episodes, suspense, and powerful verse. French romantic plays were less philosophical than German romantic plays. In addition, they depended more on such devices

as disguises and narrow escapes. Probably the most outstanding French romantic dramatist was Alfred de Musset, who explored the psychological motives of his protagonists.

Melodrama appeared along with romantic drama at the beginning of the 1800's. It helped stimulate the development of realistic scenery. Many melodramatic scenes of breathtaking escapes and such natural disasters as floods required clever, detailed settings. Melodrama appealed to a much wider audience than romantic drama, and remained popular long after the romantic movement had ended.

Early realism

By the mid-1800's, Europe was being transformed by the development of an industrial society creating new and complex social conditions. Many people believed these conditions should be studied to determine their effect on human behavior. They also felt that literature should reflect real life. As these attitudes spread throughout literature and the theater, they were reflected in the style known as realism. Realistic playwrights tried to portray the real world, which they studied by direct observation. These playwrights found their subjects in daily life and wrote dialogue in conversational prose. See **Realism**.

The popularity of melodrama stimulated the development of realistic settings and elaborate special effects. The development of the *box set* was an important step toward stage realism in the 1800's. Scenery enclosed the acting area at the back and sides, imitating the shape of a room with one wall removed. Actors tried to create the illusion of real people in a real room.

Realism was soon followed by *naturalism,* a more extreme but less influential movement. The naturalists believed that drama should become scientific in its methods. They argued that drama should either demonstrate scientific laws of human behavior or record case histories. Naturalists also placed greater emphasis on heredity and environment in determining behavior. Naturalism as a self-conscious movement declined after 1900, but by emphasizing the need for copying the details of daily life, it strengthened the realist movement. See **Naturalism**.

Directors appeared in the late 1800's, partly as a result of the growing complexity in staging. In earlier periods, a leading actor took the responsibility of staging most plays. As the demand for greater realism increased, so did the need for more careful rehearsals and better coordination of all elements. The history of the modern director is usually traced from the work of Georg II, Duke of Saxe-Meiningen. His well-rehearsed German acting company toured Europe between 1874 and 1890. This group demonstrated the value of integrating all aspects of a theatrical production into an artistic whole.

The independent theater movement developed in most European countries because commercial theaters refused to present realistic drama. Commercial theater managers feared the controversy it aroused, leading to the possibility of government opposition. Independent theaters began to appear in the 1880's. They were private organizations open only to members and could perform works that otherwise would not have been presented. The first important independent theater was the Théâtre Libre, founded in Paris in 1887 by André Antoine. The Freie Bühne was established in Berlin by Otto Brahm in 1889. The Independent Theatre Society, founded by Jacob T. Grein in London in 1891, introduced the witty plays of George Bernard Shaw to audiences in England.

Modern drama: Ibsen to World War II

Ibsen. The strongest influence in the development of realistic drama came from Henrik Ibsen, Norway's first important dramatist. Ibsen is often called the founder of modern drama. His plays were both the high point of realism and the forerunner of movements away from realism. Ibsen broke with tradition not only in technique but also in his fearless treatment of human problems. He portrayed the environment in his plays realistically. His characters reveal themselves as they would in real life—through their words and actions rather than by a statement by the author.

Ibsen's *The League of Youth* (1869) was the first of a series of plays that handled social problems realistically, though his realistic plays contain important elements of symbolism as well. *A Doll's House* (1879) and *Ghosts* (1882) were explosive attacks against the conventional morality of Ibsen's time. In *Hedda Gabler* (1891) and *The Master Builder* (1893), Ibsen intensified his focus on the mind and spirit of the individual. In his late plays, especially in *When We Dead Awaken* (1900), Ibsen increased his emphasis on symbols and mysterious forces beyond human control.

Russian drama and Chekhov. The realistic plays of the Russian writer Anton Chekhov became nearly as influential as those of Ibsen. The principal playwrights in Russia before Chekhov included Nikolai Gogol, Alexander Ostrovsky, and Ivan Turgenev. Gogol's farce *The Inspector-General* (1836) satirized small-town officials. Ostrovsky portrayed the everyday life of the merchant class in such plays as *The Storm* (1860). Turgenev's play *A Month in the Country* (completed in 1850) was a realistic study of boredom, jealousy, and compromise, elements that appear in Chekhov's plays.

Chekhov took his subjects from Russian society of his day. He skillfully created action that reflects the apparent aimlessness of life itself. As in life, comic incidents often intermingle with pathetic or tragic ones. Chekhov's greatest masterpieces are his last four plays—*The Seagull* (1896), *Uncle Vanya* (1898), *The Three Sisters* (1901), and *The Cherry Orchard* (1904).

British drama. The realistic spirit gradually influenced dramatists throughout Europe. Until the last quarter of the 1800's, the British theater was dominated by sentimental romances and melodrama. Henry Arthur

Courtesy of the Theatre Collection, New York Public Library at Lincoln Center, Astor, Lenox and Tilden Foundation

Expressionism distorts the outside world to reveal the tortured minds of the characters in the grip of fear or other violent emotions. This scene is from *The Adding Machine* by Elmer Rice.

Jones and Arthur Wing Pinero, the most popular British dramatists of the late 1800's, moved toward realism.

The plays of J. M. Barrie have some realism, but they are basically romantic and many are overly sentimental. Oscar Wilde is remembered chiefly for his brilliant comedy *The Importance of Being Earnest* (1895). Novelist John Galsworthy wrote powerful realistic plays, including *Strife* (1909), a drama about labor strikes.

George Bernard Shaw was an influential critic as well as dramatist. He supported the social and artistic ideals of Ibsen and was chiefly responsible for their spread in the United Kingdom. Most of Shaw's plays are examples of the comedy of ideas, in which the theater is used as a forum for social, political, and moral criticism.

Irish drama. A remarkable period of theatrical activity developed in Ireland during the late 1800's and extended into the 1900's. It was part of a general nationalistic revival of Irish literature known as the Irish Literary Revival. Irish drama centered around the Abbey Theatre in Dublin. It staged the plays of most major Irish dramatists, including Lady Gregory, Sean O'Casey, John Millington Synge, and William Butler Yeats.

French drama. Jean Giraudoux was probably the leading French playwright between World War I and World War II. He often used Greek myths, Biblical stories, and fantasy to make sympathetic and witty comments about humanity. Jean Cocteau also used Greek myths as the basis of his plays, but he was much more experimental in his style. Paul Claudel became famous for his religious verse plays. Jean Anouilh's many plays vary in form, but they usually take the side of youthful purity against the corrupting forces of age and greed.

United States drama. Until the early 1900's, American drama closely followed the European theater. Few American dramatists of distinction appeared until the 1800's, and none gained international recognition until Eugene O'Neill, who began writing in 1913. O'Neill's plays are a record of persistent experimentation with various styles and dramatic devices. His power is probably best revealed in his drama of tortured family relationships, *Long Day's Journey into Night.*

Other significant American dramatists of the 1920's and 1930's were Lillian Hellman; Clifford Odets, whose best plays express the political and social radicalism of the Great Depression years; Elmer Rice; and Thornton Wilder. Popular comic playwrights included the team of George S. Kaufman and Moss Hart. In this period, American musical comedy developed into an art form capable of a wide range of expression. Much of its appeal resulted from the music of composers George Gershwin, Jerome Kern, Cole Porter, and Richard Rodgers.

Italian drama. Since the late 1700's, few important Italian dramatists have appeared. A noteworthy exception is Luigi Pirandello, the leading Italian playwright of the 1900's. His plays are based on the idea that there is no single truth—only the conflicting views of individuals. Another dramatist, Ugo Betti, became famous for his tragedies about guilt and justice.

Symbolism in drama developed in France during the 1880's. The symbolists believed that appearance is only a minor aspect of reality. They believed that reality could be found in mysterious, unknowable forces that control human destiny. They argued that truth could not be portrayed by logical thought, but could only be suggested by symbols. Their plays tended to be vague and puzzling. The settings and the performers' movements and speaking style were deliberately unrealistic in an attempt to stimulate the audience to look for deeper meanings in the action. The most celebrated symbolist dramatist was Maurice Maeterlinck.

Expressionism is difficult to define because the term was used in Germany between 1910 and 1925 to describe almost any departure from realism. Most German expressionists believed that the human spirit was the basic shaper of reality. Surface appearance, therefore, was important only as it reflected an inner vision. To portray this view, expressionist playwrights used distorted sets, lighting, and costumes; short, jerky speeches; and machinelike movements. Expressionistic techniques can be seen in Georg Kaiser's *From Morn to Midnight* (1916), a symbolic story of humanity's misguided search for happiness through wealth.

Expressionism appeared in Germany about 1910. The dramatic techniques of expressionism owed much to the Swedish dramatist August Strindberg. In such plays as *To Damascus* (parts I and II written in 1898, part III written in 1901), *A Dream Play* (written in 1901), and *The Ghost Sonata* (1908), time and place shift freely. Characters multiply and merge and objects change in appearance. See **Expressionism.**

Epic theater. The discontent of the post-World War I era appeared in much drama of the 1920's and 1930's. The most fruitful attempt to focus the attention of theatergoers on political, economic, and social realities was epic theater, developed by the German dramatist Bertolt Brecht.

Brecht adopted the name *epic* to distinguish his aims from those of the traditional *dramatic* theater. He used techniques of the epic poem, including episodic action and narrative mixed with dialogue. In such plays as *Mother Courage and Her Children* (1941) and *Life of Galileo* (1943), Brecht tried to make spectators think critically and relate his plays to real-life conditions. In this way, he hoped to inspire them to change those conditions. Brecht wrote all his major works before 1945, but his greatest influence came later.

Theater of the absurd, which emerged in France during the 1950's, was probably the most influential new movement in drama after the end of World War II in 1945. The absurdists rejected conventional notions of plot, character, dialogue, and logic in favor of dreamlike metaphors that did not try to imitate surface reality. They hoped to express the disorientation of living in a universe they saw as unfriendly, irrational, and meaningless, and therefore absurd.

The most famous play of the theater of the absurd was *Waiting for Godot* (1953) by Samuel Beckett. In this work, two tramps pass the time uncomfortably while waiting for someone named Godot, who never arrives. The plays of Eugène Ionesco, particularly *The Bald Soprano* (1953), also violated conventional dramatic form. Jean Genet portrayed human behavior as a series of ceremonies expressing sexual and political desires for violence and domination.

Experimental theater. Many theater artists were influenced by the writings of French director and dramatist Antonin Artaud. They were drawn to Artaud's demand for an intense, rigorous theater free from the domination of playwrights.

Americans Julian Beck and Judith Malina established the Living Theater in 1951. The Living Theater worked to abolish the conventional boundaries between theater and politics, between actors and spectators, and between stage and auditorium. Joseph Chaikin, a former Living Theater actor, later founded the Open Theater in New York City. The productions and writings of Polish director Jerzy Grotowski also influenced experimental theater. In the 1970's, experimental theater lost much of its crusading determination to change the world.

Later German-language drama reflects the influence of both epic and absurdist theater. Swiss dramatist Friedrich Dürrenmatt's *The Visit* (1956) and *The Physicists* (1962) are dark parables about crime, guilt, responsibility, and justice. German playwright Peter Weiss's powerful *Marat/Sade* (1964) features an anguished reconsideration of the French Revolution by inmates of a mental institution. Austrian dramatist Peter Handke and German playwright Heiner Müller wrote plays in the absurdist tradition. German dramatist Franz Xaver Kroetz wrote harsh, naturalistic plays of stinging social criticism.

Bert Lahr, *left,* and E. G. Marshall, *right,* in a scene from *Waiting for Godot* by Samuel Beckett; Elliot Erwitt, Magnum

Theater of the absurd was a broad movement that included many important new playwrights of the 1950's. Samuel Beckett wrote about helpless characters who lead meaningless lives.

Later British drama. T. S. Eliot and Christopher Fry briefly renewed verse drama in Britain after World War II. A new period in British drama began with John Osborne's *Look Back in Anger* (1956). This realistic play gave a voice to the rebellious spirit of a group of writers eventually called the "angry young men." Along with the plays of Brecht and Beckett, *Look Back in Anger* stimulated a new generation of British playwrights.

Harold Pinter is Beckett's most important follower. Pinter's plays create a menacing atmosphere from everyday events and seemingly realistic dialogue. John Arden, Edward Bond, Caryl Churchill, David Hare, and Arnold Wesker wrote as political radicals. Joe Orton wrote cynical, dark farces. Tom Stoppard writes intellectual comedies. Other notable British playwrights include Alan Ayckbourn, Michael Frayn, Peter Nichols, and Peter Shaffer. In spite of their differences in form, they all expressed their discontent with modern British life.

Later United States drama. Tennessee Williams and Arthur Miller became the leading American dramatists of the 1940's and 1950's. Both playwrights combined realistic dialogue with expressionistic staging. Both were also accurate observers of American life, Williams in the South and Miller in the North. But Williams demanded compassion for the doomed dreamers in his plays, while Miller dealt judgment to guilty strivers. In such plays as *The Glass Menagerie* (1945) and *A Streetcar Named Desire* (1947), Williams wrote of faded Southern belles who were not equipped to function in the turbulent United States of the 1900's. In *Death of a Salesman* (1949), Miller used a common man's personal failure to criticize society's focus on material success.

In the 1950's, small theaters sprang up in several neighborhoods of Manhattan in New York City. These theaters became known collectively as *off-Broadway.* They introduced many American playwrights, notably Edward Albee. Albee's successful play *Who's Afraid of Virginia Woolf?,* a wry, grim drama of domestic discord, was first produced on Broadway in 1962.

During the 1960's, the Broadway comedies of Neil Simon became tremendously popular. But in general, the Broadway theater, the traditional arena for American plays, declined. Meanwhile, performances of new plays by new dramatists flourished in lofts, basements, cafes, and other venues. These productions formed the basis of what has become known as the *off-off-Broadway* movement.

Also around the 1960's, new voices in the American theater began expressing various ethnic, sexual, political, and aesthetic concerns. At this time, numerous important black playwrights saw their work find an audience in the postwar American theater. Lorraine Hansberry's *A Raisin in the Sun* (1959) was the first play by a black dramatist to achieve major success on Broadway.

During the late 1900's, noncommercial theaters took up the functions that Broadway had performed, especially the presentation of new plays. For example, Sam Shepard's hallucinatory family plays *Curse of the Starving Class* and *Buried Child* (both 1978) were first presented at the New York Shakespeare Festival in New York and the Magic Theater in San Francisco, respectively. David Mamet, a harsh critic of dishonesty in American life, began his career in Chicago, where his *American Buffalo* was first produced in 1975. Lanford Wilson, au-

James Earl Jones, *second from right,* in a scene from *Fences* (William B. Carter)

African American playwrights became a major force in American drama in the middle and late 1900's. August Wilson gained acclaim for his cycle of plays on black life, including *Fences,* shown here.

thor of three plays about the Talley family of Lebanon, Missouri, was a founder of the Circle Repertory Company in New York City. David Rabe, best known for his plays about the Vietnam War (1957-1975), was sponsored by the New York Shakespeare Festival.

August Wilson became the leading African American dramatist during the 1980's. His cycle of plays reflects African American life in each decade of the 1900's. Wendy Wasserstein wrote several popular comedies about women, most notably *The Heidi Chronicles* (1988).

A number of homosexual playwrights began to write openly about gay lifestyles. The most significant plays include *As Is* (1985) by William Hoffman, *The Normal Heart* (1985) by Larry Kramer, and *Love! Valour! Compassion!* (1994) by Terrence McNally. Tony Kushner's two-play *Angels in America* (1993) was perhaps the most celebrated of these plays, making gay men the central characters in a complex allegory of modern American life.

Drama in other countries reflects the impact of troubled local histories. South African playwright Athol Fugard writes realistic plays that involve *apartheid* (South Africa's policy of racial separation from 1948 to 1991) and its aftermath. Wole Soyinka's plays show Nigeria caught between traditional and modern ways of life. Dario Fo of Italy writes broadly comic but satiric plays from a left-wing perspective. Julius Novick

Study aids

Related articles. See **Theater** and its list of *Related articles.* See also such literature articles as **American literature** and the following articles:

American playwrights

Albee, Edward
Anderson, Maxwell
Baraka, Amiri
Barry, Philip
Behrman, S. N.
Belasco, David
Cohan, George M.
Connelly, Marc
Dunlap, William
Fitch, Clyde
Gillette, William
Glaspell, Susan
Green, Paul E.
Hansberry, Lorraine
Hart, Moss
Hecht, Ben
Hellman, Lillian
Herne, James A.
Howard, Sidney
Inge, William
Kaufman, George S.
Kelly, George E.
Kingsley, Sidney
Lindsay, Howard
Luce, Clare Boothe
Mamet, David
McCullers, Carson
McNally, Terrence
Miller, Arthur
Moody, William Vaughn
Odets, Clifford
O'Neill, Eugene G.
Payne, John Howard
Rice, Elmer
Saroyan, William
Shaw, Irwin
Shepard, Sam
Sherwood, Robert E.
Simon, Neil
Tyler, Royall
Van Druten, John W.
Wasserstein, Wendy
Wilder, Thornton N.
Williams, Tennessee
Wilson, August
Wilson, Lanford

British playwrights

Ayckbourn, Alan
Barrie, J. M.
Beaumont, Francis
Behn, Aphra
Bulwer-Lytton, Edward
Chapman, George
Congreve, William
Coward, Noël
Davenant, Sir William
Dekker, Thomas
Dryden, John
Eliot, T. S.
Etherege, Sir George
Farquhar, George
Fletcher, John
Ford, John
Fry, Christopher
Galsworthy, John
Gascoigne, George
Gay, John
Gilbert and Sullivan
Goldsmith, Oliver
Granville-Barker, Harley
Gray, Simon
Greene, Robert
Heywood, Thomas
Jonson, Ben
Kyd, Thomas
Lyly, John
Marlowe, Christopher
Marston, John
Massinger, Philip
Maugham, W. Somerset
Osborne, John
Pinero, Arthur Wing
Pinter, Harold
Priestley, John Boynton
Shaffer, Peter
Shakespeare, William
Shaw, George Bernard
Sheridan, Richard Brinsley
Sillitoe, Alan
Stoppard, Tom
Vanbrugh, Sir John
Webster, John
Wilde, Oscar
Williams, Emlyn
Wycherley, William

French playwrights

Anouilh, Jean
Beaumarchais, Pierre de
Beckett, Samuel
Brieux, Eugène
Camus, Albert
Claudel, Paul
Cocteau, Jean
Corneille, Pierre
Dumas, Alexandre, *fils*
Dumas, Alexandre, *pere*
Genet, Jean
Giraudoux, Jean
Hugo, Victor
Ionesco, Eugène
Marivaux, Pierre
Molière
Musset, Alfred de
Racine, Jean
Rostand, Edmond
Sartre, Jean-Paul
Scribe, Augustin Eugène
Voltaire

German language playwrights

Brecht, Bertolt
Büchner, Georg
Dürrenmatt, Friedrich
Frisch, Max
Goethe, Johann W. von
Hauptmann, Gerhart
Hofmannsthal, Hugo von
Kaiser, Georg
Kleist, Heinrich von
Lessing, Gotthold E.
Schiller, Johann von
Schnitzler, Arthur
Sudermann, Hermann
Wedekind, Frank

Irish playwrights

Boucicault, Dion
Dunsany, Lord
Friel, Brian
Gregory, Lady
O'Casey, Sean
Synge, John Millington
Yeats, William Butler

Italian playwrights

Alfieri, Vittorio
D'Annunzio, Gabriele
Goldoni, Carlo
Pirandello, Luigi

Russian playwrights

Chekhov, Anton
Gogol, Nikolai
Gorki, Maxim
Pushkin, Alexander

Scandinavian playwrights

Bjørnson, Bjørnstjerne
Holberg, Ludvig
Ibsen, Henrik
Lagerkvist, Pär F.
Strindberg, August

Spanish playwrights

Benavente, Jacinto
Calderon de la Barca, Pedro
García Lorca, Federico
Tirso de Molina
Vega, Lope de

Ancient Greek and Roman playwrights

Aeschylus
Aristophanes
Euripides
Menander
Plautus
Seneca, Lucius A.
Sophocles
Terence
Thespis

Other playwrights

Čapek, Karel
Fugard, Athol
Havel, Václav
Maeterlinck, Maurice
Molnár, Ferenc
Soyinka, Wole
Walcott, Derek

Other related articles

Burlesque
Comedy
Masque
Miracle play
Morality play
Musical comedy
Mystery play
Opera
Passion play
Pulitzer Prizes (table: Drama)
Tragedy
United States (The arts [picture])

Outline

I. Forms of drama
II. The structure of drama
III. Greek drama
IV. Roman drama
V. Medieval drama
VI. Italian Renaissance drama
VII. Elizabethan, Jacobean, and Caroline drama
VIII. The Golden Age of Spanish drama
IX. French neoclassical drama
X. European drama: 1660-1800
XI. Asian drama
XII. Romanticism
XIII. Early realism
XIV. Modern drama: Ibsen to World War II
XV. Modern drama since World War II

Questions

What are three leading theories about the origin of drama?
What was the influence of Thomas Kyd on Elizabethan drama?
What is the function of the plot of a play?
What were the major theories that shaped French neoclassicism?
What were some differences between Old Comedy and New Comedy?
What was the comedy of manners? What was emphasized in a sentimental comedy?
What contribution did the Greek playwright Sophocles make to dramatic form?
What role did the church play in the rebirth of drama during the Middle Ages?
What is the theme of most absurdist drama?
What are the three most important traditions in Japanese drama?
What were Victor Hugo's contributions to the rise of romanticism in drama?

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Dramamine is the G. D. Searle Company's trade name for a drug used to prevent motion sickness, and to control nausea and vomiting in certain illnesses. Dramamine is one of the antihistaminic drugs. It acts as a mild sedative to reduce the activity of the central nervous system. Large doses may cause drowsiness. Its generic name is *dimenhydrinate.* N. E. Sladek

See also **Antihistamine; Motion sickness.**

Draughts. See **Checkers.**

Dravidians, *druh VIHD ee uhnz,* were among the earliest known inhabitants of India. Their descendants now live mainly in southern India and trace their ancestry back at least 4,500 years. Dravidians and Indo-Aryans form the two major ethnic groups of India.

The term *Dravidian* also refers to a family of about 20 languages. Four of the languages are spoken by about 200 million Indians, about a fifth of the country's population. The Indian government has formed separate states based on these four languages. Tamil is spoken in the state of Tamil Nadu, Telugu in Andhra Pradesh, Kannada in Karnataka, and Malayalam in Kerala.

The origin of the Dravidians remains unknown. But ruins of the cities of Harappa and Mohenjo-Daro in the Indus Valley civilization, which began about 2500 B.C., revealed an advanced culture thought to be Dravidian. About 1500 B.C., a people of central Asia called the Aryans conquered the Dravidians in northern India and drove some of them south. From about the A.D. 300's to 600's, Dravidian kings valued *Brahmans* (Hindu priests and scholars) from northern India for their literary skills and adopted much of their heritage.

Since the early 1900's, however, Dravidians have organized movements against remaining aspects of the Brahman heritage. During the 1960's, Tamil-speaking Indians were especially violent in protesting against a ruling that would have made Hindi, an Indo-European language, India's only official language. Today, 4 of the country's 18 official languages are Dravidian.

Robert Eric Frykenberg

See also **India** (People; History).

Drawing is the act of making a design or image, using line or tone, on any suitable surface. The design or image itself is also called a drawing. Drawings can be made for artistic or technical purposes. This article discusses drawing as a fine art. For information on technical drawing, see **Mechanical drawing.**

Purposes. Artists create drawings for a variety of purposes. Many artists make preliminary drawings to help them develop the composition of a painting or sculpture. They also produce drawings as finished works of art. Artists may use drawings to record information for future use. For example, an artist may draw a detailed sketch of a tree and refer to the drawing later when incorporating the tree into a painting. Art students draw figures and objects to gain skill with line and form.

Materials and techniques. Artists draw with chalk, charcoal, crayon, or pencil. They may use a liquid, such as ink, applied with a brush or pen. Artists also scratch drawings into a surface. For example, a *silverpoint drawing* is made by scratching into specially coated paper with a silver instrument or silver wire.

Portrait of Isabella Brant (about 1625); The British Museum, London

A chalk drawing can be as delicate and realistic as a painting. The Flemish artist Peter Paul Rubens used black, red, and white chalk to draw this expressive portrait of his wife.

Color Intervals at Provincetown (1943); Addison Gallery of American Art, Phillips Academy, Andover, Mass.

A crayon drawing may have a forceful, dramatic quality. The German artist Hans Hofmann drew his forms in crayon and outlined them in ink to create this almost abstract picture of a town.

Manufacturers produce chalk and ink in a wide range of colors. Brushes, pencils, and pens are made in a variety of widths to create different kinds of lines. Artists can add tone to a drawing by applying a thin layer of liquid color called a *wash*. They also may combine several materials and techniques in one drawing.

Almost any surface can be used for a drawing. Prehistoric people drew on clay and stone, and the ancient Chinese used silk cloth. In the Middle Ages, many artists drew on parchment. Since the 1400's, paper has been the most popular surface because it is inexpensive and easy to carry. Drawing paper is made in many colors and textures, and in various degrees of absorbency.

Preliminary study for the portrait *Comtesse d'Haussonville* (1845); © The Frick Collection, New York City

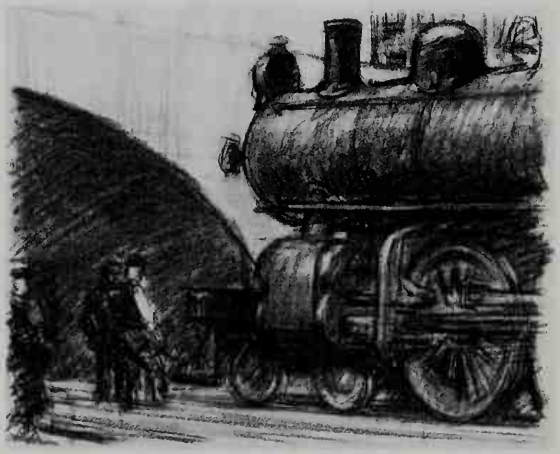
A drawing is often used as a preliminary study for a painting. The finished painting of this sketch by the French artist Jean A. D. Ingres appears in the *World Book* article on **Painting**.

History. People have made drawings since prehistoric times. This art form first gained popularity among European artists during the 1400's, when paper became generally available. Since then, each century has produced artists who have created great drawings.

Masters of drawing in the 1400's and 1500's included Leonardo da Vinci, Albrecht Dürer, Michelangelo, and Raphael. During the 1600's, Claude, Nicolas Poussin, Rembrandt, and Peter Paul Rubens created important drawings. In the 1700's, great drawings were produced by Jean Honoré Fragonard, Francisco Goya, Giovanni Battista Tiepolo, and Antoine Watteau. The masters of drawing during the 1800's included Paul Cézanne, Jacques Louis David, Edgar Degas, Théodore Géricault, Jean Ingres, Odilon Redon, Henri de Toulouse-Lautrec,

Landscape with Satyr (early 1500's) attributed to Titian; © The Frick Collection, New York City

A pen-and-ink drawing shows how forms can be developed by the combination of lines and blank areas. Artists often choose pen and ink to create a drawing with many details.



The Locomotive (1923); Philadelphia Museum of Art, the Harrison Fund

A charcoal drawing can effectively portray large, solid forms. The American artist Edward Hopper emphasized dark, heavy shapes to show a massive locomotive in front of a dark tunnel.

and Vincent van Gogh. Great drawings in the 1900's were created by Max Beckmann, Willem de Kooning, Arshile Gorky, Edward Hopper, Paul Klee, Oscar Kokoschka, Käthe Kollwitz, Henri Matisse, Jules Pascin, and Pablo Picasso. Roger Ward

See also **Leonardo da Vinci** (pictures); **Painting** (Water color); **Cartoon; Comics.**

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Drayton, Michael (1563-1631), was an English poet who experimented with many literary forms. Drayton wrote a number of love sonnets, though he concentrated on English patriotic themes in his works.

Drayton was born in Warwickshire and settled in London about 1591 to pursue a literary career. His first works included the sonnets *Idea, the Shepherd's Garland* (1593) and *Idea's Mirror* (1594). Drayton's major work was his long poem *Poly-Olbion* (1612-1622), a geographical and historical survey of England's counties. It was influenced by Edmund Spenser's epic poem *The Fairie Queene.* Drayton's poem *Nymphidia* (1627) pays homage to Geoffrey Chaucer, Spenser, and William Shakespeare in a mythological setting. John N. King

Dream is a story that a person "watches" or appears to take part in during sleep. Dream events are imaginary, but they are related to real experiences in the dreamer's life. They seem real to the dreamer while they are taking place. There are many types of dreams. Some are pleasant, others are annoying, and still others are frightening (see **Nightmare**).

Everyone dreams, but some people never recall dreaming. Others remember only a little about a dream they had just before awakening and nothing about earlier dreams. No one recalls every dream and, in general, dreams are very easily forgotten.

What dreams consist of. The events of a dream usually form a story. In some dreams, the dreamer takes part in the story. In others, the dreamer merely "watches" the tale unfold. In most dreams, the dreamer cannot control what is happening, there is little logical thought, and events occur that could not happen in real life. Occasionally, the dreamer will realize that he or she is dreaming and may be able to alter what happens in the dream without waking up. This is known as a *lucid dream.*

People see in most dreams, and they may also hear, smell, touch, and taste in them. Most dreams occur in color, though the color is often recalled only vaguely. Dreaming thought seems to put things together in new and unexpected ways. In some cases, this has led to important scientific discoveries or highly imaginative creative works.

The biology of dreams. Dreaming, like all mental processes, is a product of the brain and its activity. Whether a person is awake or asleep, the brain continuously gives off electrical waves. Scientists measure these waves with an instrument called an *electroencephalograph* (see **Electroencephalograph**). Most of the time when a person is sleeping, the brain waves are large and slow. But at certain times, they become smaller and faster. During the periods of fast brain waves, the person's eyes move rapidly as though the sleeper were watching a series of events. This stage of sleep, called *REM* (*R*apid *E*ye *M*ovement) *sleep,* is when most dreams occur. If awakened during REM sleep, the person having the dream is likely to recall details of the dream. Most adults have three to five REM periods each night. They occur every 90 to 100 minutes and last from 5 to 30 minutes each. But not all dreams come from REM periods. Some people report dreamlike mental activity when awakened from non-REM sleep or as they are falling asleep.

During REM sleep, the pathways that carry nerve impulses from the brain to the muscles are blocked. Therefore, the body cannot move during dreams. Also, the *cerebral cortex*—the part of the brain involved in higher

mental functions—is much more active during REM sleep than during nondreaming sleep. The cortex is stimulated by *neurons* (nerve cells) that carry impulses from the part of the brain called the *brain stem.*

The meanings of dreams. Dreams include events and feelings that the dreamer has experienced. Most dreams are related to events of the day before the dream, and many minor incidents of the hours before sleep appear in dreams.

Many experts who study dreams also feel that they are related to deep wishes and fears of the dreamer, and several theories explaining the meaning of dreams have been developed. During the 1890's, Sigmund Freud, an Austrian physician who originated psychoanalysis, developed one of the best-known theories of dream interpretation. Freud suggested that dreams are fulfillments of wishes, usually in disguised form. The disguise—or "dream language"—involves *condensation* (combining several ideas into one image), *displacement* (shifting a feeling from one idea or person to another), and *symbolism* (the use of symbols to represent what cannot be pictured directly).

Some scientists have suggested that biological discoveries about dreaming have made psychological theories of dreaming, such as Freud's, unnecessary or false. These scientists argue that a dream is a meaningless response of the cerebral cortex to random stimulation from the brain stem. However, waking thought is also a response of the cerebral cortex to stimulation, often random, from the brain stem. Therefore, the biology involved does not make dreams meaningless any more than it makes waking thought meaningless. Most psychiatrists and psychologists still consider dreams psychologically meaningful.

Functions of dreams. The function of dreaming is not completely understood. Dreaming sleep may play a role in restoring the brain's ability to handle such tasks as focused attention, memory, and learning. In addition, most psychiatrists and psychologists still believe that a person's hidden feelings often surface in dreams. Psychotherapists therefore analyze patients' dreams in an effort to help the patients understand themselves better.

Ernest Hartmann

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Dred Scott Decision was an important ruling by the Supreme Court of the United States on the issue of slavery. The decision, which was made in 1857, declared that no black—free or slave—could claim United States citizenship. It also stated that Congress could not prohibit slavery in United States territories. The ruling aroused angry resentment in the North and led the nation a step closer to civil war. It also influenced the introduction and passage of the 14th Amendment to the U.S. Constitution after the Civil War (1861-1865). The amendment, adopted in 1868, extended citizenship to former slaves and gave them full civil rights.

The background of the case. Dred Scott was the slave of a U.S. Army surgeon, John Emerson of Missouri, a state that permitted slavery. In 1834, Scott went with Emerson to live in Illinois, which prohibited slavery. They later lived in the Wisconsin Territory, where slavery was forbidden by the Missouri Compromise. In 1838, Scott returned to Missouri with Emerson. Emerson died there in 1843, and three years later Scott sued the surgeon's widow for his freedom.

Missouri Historical Society
Dred Scott

Scott based his suit on the argument that his former residence in a free state and a free territory—Illinois and Wisconsin—made him a free man. A state circuit court ruled in Scott's favor, but the Missouri Supreme Court later reversed the decision. Meanwhile, Scott had become legally regarded as the property of John F. A. Sanford (spelled Sandford in the U.S. Supreme Court records) of New York. Because Sanford did not live in Missouri, Scott's lawyers were able to transfer the case to a federal court. This court ruled against Scott, and his lawyers then took the case to the Supreme Court.

The Supreme Court ruling. By a majority of 7 to 2, the Supreme Court ruled that Scott could not bring a suit in a federal court. Chief Justice Roger B. Taney, speaking for the majority, declared that Scott could not do so because blacks were not U.S. citizens.

The court could have simply dismissed the case after ruling on Scott's citizenship. But there was a growing national desire for a ruling on the constitutionality of such laws as the Missouri Compromise. Therefore, the court discussed this issue as part of its decision in the Dred Scott case. By a smaller majority, it ruled that the Missouri Compromise, which had been repealed in 1854, was unconstitutional. Taney argued that because slaves were property, Congress could not forbid slavery in the territories without violating a slaveowner's constitutional right to own property.

Dred Scott himself was sold shortly afterward. His new owner gave him his freedom two months after the Supreme Court decision.

Stanley I. Kutler

See also **Missouri Compromise; Taney, Roger B.**

Additional resources

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Dredging, *DREHJ ihng,* is the work of clearing out the bottom of rivers, harbors, and other bodies of water so that ships can use them. The machines that do the work are called *dredges.* They work somewhat as a *power shovel* does on land. Dredges usually are run by steam or diesel engines.

The *dipper dredge* has a large scoop shovel, or *dipper,* that is shaped like a box, which hangs on a chain from a long steel beam. The steel beam, or *derrick,* is attached to a strong mast. The mast can swing the beam and the dipper in a wide semicircle. The chain can be wound and unwound to raise and lower the dipper, and

the derrick also can be raised and lowered.

When the dredging begins, the dipper is lowered to the bottom of the river or harbor. The derrick arm is swung in a semicircle to drag the dipper across the bottom so that it scoops up dirt and mud. Then the dipper is raised above the water and swung above a barge nearby. The bottom of the dipper has a door that is pulled open by a long cord to dump the dirt into the barge. Then the dipper is again lowered beneath the water to dig more mud.

The first steam dredge was used in England in 1796. It consisted of a 4-horsepower (3-kilowatt) steam engine mounted on a dredger that dug with long-handled ladles. In the early 1800's, steam-driven bucket and chain dredges came into common use. Diesel engines were first installed on dredges in the United States in the early 1920's.

The *hydraulic dredge* is particularly efficient for moving beach or river sand. A suction pipe carries the sand and water to a pump. A discharge pipe leads from the pump to a barge or to a disposal area. Earth deposited by this process for dams, dikes, or building sites is called *hydraulic fill.* Larry W. Mays

See also **Mining** (Surface mining methods; picture).

Dreiser, *DRY suhr,* **Theodore** (1871-1945), ranks as the foremost American writer in the *naturalism movement* (a pessimistic form of realism). Dreiser's characters are victims of apparently meaningless incidents that result in pressures they can neither control nor understand. He based such novels as *Sister Carrie* and *An American Tragedy* on events from real life. He condemned not his villains, but the repressive, hypocritical society that produced them. Dreiser's style lacks grace, but his best stories are powerful and sobering.

Dreiser was born in Terre Haute, Ind. His older brother was Paul Dresser, who wrote the song "On the Banks of the Wabash, Far Away." Dreiser's family was very poor, and he soon saw a profound difference between the promise and the reality of American life. This realization was a major source of Dreiser's discontent and an important influence on his works.

Dreiser attended Indiana University for a year. In the 1890's, he worked as a newspaperman in Chicago and St. Louis. By 1907, he was the successful editor of the very sort of woman's magazine whose sentimentality and superficiality he despised.

Dreiser's first novel, *Sister Carrie,* was partly based on the experiences of one of his sisters. The novelist Frank Norris, an editor at Doubleday, Page, and Co., enthusiastically accepted the manuscript for publication. But Neltje Doubleday, wife of the president of the company, was shocked by the manuscript's amorality, and the publisher tried to cancel the contract to publish the book. Dreiser insisted the agreement be honored. Doubleday printed the book in 1900, but did not advertise or distribute it. The novel became generally available in 1912, after another publisher issued it.

Sister Carrie is the story of Carrie Meeber, a poor girl alone in Chicago. She lives with a traveling salesman and then runs off to New York with George Hurstwood, a prosperous married man. Hurstwood's fortunes decline, and he becomes a bum and commits suicide. Carrie finds success, but not happiness, as an actress.

Dreiser wrote *Jennie Gerhardt* (1911), another novel of desire and fate. However, his reputation was assured with the publication of *The Financier* (1912), the most purely naturalistic of his works. It is the story of an industrial tycoon who claws his way to great power. Dreiser intended the novel as the beginning of a "Trilogy of Desire." But the second volume, *The Titan* (1914), was a failure, and the third volume, *The Stoic,* was not published until two years after his death.

An American Tragedy (1925) is the finest of Dreiser's books. It concerns a weak young man who is executed for the murder of his pregnant girl friend. Again, Dreiser did not condemn his villain, but the amoral society that produced and destroyed him. Samuel Chase Coale

Dresden (pop. 490,571) is one of the largest cities in Germany and a major European art center. The city lies on both banks of the Elbe River in east-central Germany. For location, see **Germany** (political map).

Dresden was one of the most beautiful cities in Europe before World War II (1939-1945). In February 1945, Allied bombing raids killed thousands of people in Dresden and destroyed much of the city, including most of its architectural monuments. Restoration of these historic buildings has been underway since the 1950's. The first historic building to be restored was the Zwinger, a museum complex that is an outstanding example of the decorative Baroque architectural style. The Zwinger, built in the 1700's, houses a magnificent art collection. Its treasures include many porcelain artworks, priceless jewels, and paintings by famous old masters.

Much of Dresden has been rebuilt in a modern style since 1945. The city has many broad streets lined with boxlike concrete buildings. Dresden's main shopping area lies along Pragerstrasse, a street reserved for pedestrians. The city is the home of Dresden Technical University and several other schools.

Dresden is more important as an area of industrial research and development than as a manufacturing center. Its products include drugs, electronics equipment, furniture, optical and precision instruments, and machinery. The world-famous Dresden china is produced in nearby Meissen (see **Dresden china**).

German settlers from Meissen founded Dresden in the early 1200's. In the 1400's, the city became the capital of Saxony, the kingdom of a people called Saxons. During the next 400 years, Saxon rulers established and enlarged Dresden's art collection and made the city an important art center. After Saxony became part of the German Empire in 1871, Dresden also gained importance as a commercial center.

The German government hid Dresden's art treasures outside the city during World War II. Soviet troops seized the collection in 1945, though most of it was returned in the 1950's. Much of Dresden was rebuilt but without its former splendor. Melvin Croan

Dresden china, *DREHZ duhn,* is a type of porcelain that is produced in Meissen, Germany, near the city of Dresden. The Meissen factory became the first manufacturer to produce true porcelain in Europe.

The Meissen porcelain factory was established in 1710. The factory was directed by the German chemist Johann Böttger. In 1708, Böttger became the first European to make porcelain. At first, the factory produced hard red stoneware. In 1713, it began making the white porcelain for which it became famous.

Hard-paste porcelain by Johann Kändler; The Art Institute of Chicago

A Dresden china bowl was designed about 1737 by Johann Kändler as part of a tableware set called the *Swan Service.*

The first great artistic period at the Meissen factory began in 1720, under the direction of Johann Höroldt, a German painter. Höroldt specialized in enameling Chinese landscapes and European scenes on porcelain (see **Enamel**). The European scenes featured featherlike trees and exotic floral designs.

In 1733, the German sculptor Johann Kändler became factory director and designed beautiful Meissen porcelain ornamental figures and tableware. Kändler designed the famous *Swan Service* (1737-1741), a set of tableware in which the pieces were decorated with the raised figures of dolphins, swans, water plants, and mythical maidens. Kändler also introduced realistic porcelain flowers, which became one of the Meissen factory's most distinctive designs.

Meissen porcelain was first called Dresden china in the 1700's. The Meissen factory still produces porcelain today. Its trademark of two crossed swords remains one of the most famous in pottery. William C. Gates, Jr.

See also **Porcelain; Böttger, Johann Friedrich.**

Drew, Charles Richard (1904-1950), was an African American physician known for his research on blood plasma and for setting up blood banks. During the late 1930's, he and another American physician, John Scudder, did pioneering research on the problems of fluid balance in the body, especially following trauma. They demonstrated the importance of early plasma transfusions in emergency medical situations. Plasma research was important because, at the time, plasma could be kept for much longer periods of time than could whole blood. In addition, plasma could be given to a person without waiting for blood-type studies.

During the early part of World War II (1939-1945), Drew organized many blood bank programs. He and his associates developed standardized methods for banking blood and shipping plasma overseas. The plasma collected by blood banks saved millions of lives.

Drew was born in Washington, D.C. He graduated from McGill University Medical School in 1933. Drew did most of his research on plasma at Columbia University from 1938 to 1940. In 1941, he became medical director of the Red Cross program that collected plasma for the United States armed forces. Drew left the Red Cross in 1941 and became a professor of surgery at Howard University and chief surgeon at Freedmen's Hospital, which is associated with Howard. The National Association for the Advancement of Colored People awarded Drew the Spingarn Medal in 1944. That same year, he was appointed chief of staff at Freedmen's Hospital. Drew became its medical director in 1946.

Drew died as a result of injuries received in an automobile accident in April 1950. A well-known, but inaccurate, account says that Drew was denied treatment at a local hospital because he was black. In fact, the hospital staff treated Drew as best they could, but he died less than three hours after the accident. Dale C. Smith

Drexel, Saint Katharine (1858-1955), was the second person born in the United States to be recognized as a saint by the Roman Catholic Church. She was *canonized* (declared a saint) in 2000. Saint Elizabeth Ann Seton was the first, canonized in 1975.

Sisters of the Blessed Sacrament

Saint Katharine Drexel

Catherine Mary Drexel was born in Philadelphia into a wealthy and socially prominent family. She later changed the spelling of her first name to Katharine. She used her inherited wealth sponsoring mission schools and churches throughout the United States serving Native American and African American communities. She took her religious vows in 1891. That same year, she founded the Sisters of the Blessed Sacrament. She directed the religious order for more than 40 years.

Critically reviewed by the Sisters of the Blessed Sacrament

Dreyfus affair, *DRAY fuhs* or *DRY fuhs,* was a political scandal that reshaped French politics in the 1890's and early 1900's. In October 1894, the French army accused one of its officers, Captain Alfred Dreyfus (1859-1935), of selling military secrets to Germany. Almost the only evidence against him was a secret document that a French agent found in the wastepaper basket of Lieutenant Colonel Maximilian von Schwartzkoppen, a German military attaché in Paris. Handwriting on the document resembled that of Dreyfus. In December 1894, a court-martial condemned Dreyfus to life imprisonment on Devils Island in French Guiana.

Efforts to clear Dreyfus's name. In 1896, Lieutenant Colonel Georges Picquart, chief of the statistical section of the French general staff, found evidence suggesting that the real traitor was another officer, Major Marie Charles Ferdinand Walsin-Esterhazy. Probably to halt Picquart's investigation, Picquart's army superiors transferred him to northern Africa. In 1898, a court-martial failed to convict Major Esterhazy.

Soon after the Esterhazy trial, the French novelist Émile Zola stunned Paris by publishing an article condemning French military leadership for framing Dreyfus. Zola's article, *J'accuse,* resulted in a well-publicized trial in which he was convicted of libel. The article and trial made the Dreyfus case famous in France and abroad.

Conservative supporters of the French army and of

the Roman Catholic Church formed the core of the *anti-Dreyfusards,* those who believed in Dreyfus's guilt. These conservatives were joined by *anti-Semites* (people prejudiced against Jews) who insisted that Dreyfus, a Jew, could not have been a loyal Frenchman. Those who rallied to Dreyfus's defense, called *Dreyfusards,* included intellectuals as well as socialists and other left-wing politicians. These Dreyfusard groups were eager to correct an injustice, but also to gain an advantage over the moderates who controlled the French government. The ruling moderates had close links to the conservatives who belonged to the anti-Dreyfusards.

In 1899, the French court of appeals ordered a new court-martial after the discovery that forged documents had been used to support the army's weak case against Dreyfus. This second court-martial returned the verdict of guilty but "with extenuating circumstances." French President Émile Loubet then pardoned Dreyfus. In 1906, the court of appeals cleared Dreyfus of all charges. Dreyfus, who was actually conservative and deeply patriotic, served in the French army in World War I (1914-1918) and retired with the rank of lieutenant colonel.

The result of the Dreyfus affair was a rearrangement of French politics. Formerly divided left-wing groups found enough common ground in the affair to form the Radical Party and the Socialist Party. The creation of these parties shifted the balance of power in the French Parliament toward the leftists for most of the first half of the 1900's. The Dreyfus affair also led to an increase in anti-Semitism in France. This development helped convince Austrian journalist Theodor Herzl that Jews could never find a home in non-Jewish societies. As a result, he organized a worldwide Zionist movement, which inspired the founding of a Jewish homeland in Palestine. Douglas Porch

See also **France** (The Third Republic); **Jews** (The Zionist movement); **Zionism; Zola, Émile.**

Drill is a tool used to bore holes into a variety of materials. These materials range from soft soil to hard rock, metal, plastics, and concrete. Drills are widely used to bore holes into wood or metal so screws or other fasteners can be inserted. Construction workers use drills to break up pavement and to dig foundations for buildings. Energy companies rely on drills to dig for oil and natural gas and to get rock samples. Dentists use small air-powered or electric drills to remove tooth decay.

Some drills are small and hand-operated. There are also handheld power drills. Drills called *drill presses* are mounted on tables or stand on the floor. Large drills must be mounted on masts supported by trucks or rigs.

The first drills were thin pieces of wood with points of sharp rock tied to them. They were invented about 4000 B.C. The Italian artist and inventor Leonardo da Vinci designed the first mechanical drill about A.D. 1495. In 1917, the first practical handheld power drill was patented. This article describes drills for metal, wood, and rock.

Metal drills turn a slender steel rod called a *bit.* Bits are removable and come in various sizes to make different-sized holes. One end of the bit fits into the drill. The other end of the bit has one or more cutting edges called *lips.* The lips can be either a permanent part of the bit or a detachable piece called an insert. When the drill turns the bit at high speed, the lips cut into the metal to make a hole. Bits also have grooves called *flutes.* As the bit rotates, flutes direct metal shavings out of the hole so the hole does not clog and cause the drill to jam. Flutes also allow cooling liquids to flow into the hole to prevent the bit from overheating.

Most metal drill bits are *twist bits.* Twist bits have two or more lips and two or more spiraling flutes. A special bit called a *spade bit* is used in many manufacturing processes to drill deep holes. A spade bit is a flat blade with one lip. The bit is clamped in a holder before it is fitted into the drill.

Wood drills usually use specially fluted twist bits called *auger bits.* An auger bit is easy to keep centered because it has a screwlike tip called a *feed screw.* Auger bits called *Jennings bits,* with two flutes, are used in hand-operated drills. Handheld power drills take auger bits called *power bits,* which have one spiraling flute. See **Woodworking** (pictures).

Rock drills are power drills that use a hammering action, a plowing action, or both. A *paving breaker,* also called a *jackhammer,* rapidly hammers a chisellike bit into such materials as concrete and blacktop. Jackhammers are often used to break up roads, wreck buildings, and dig trenches (see **Pneumatic tool**). Drills that plow without hammering are called *rotary* drills. Among rotary bits are *fishtails,* which have hardened carbon lips, and *diamond bits.* Diamond bits are studded with points of diamond to cut hard rock. They are often used in small, handheld drills to get samples of underground rock or ore. Rotary drills called *augers* have steel screw threads. Augers are often used to drill oil wells (see **Petroleum** [Drilling an oil well]). M. O. M. Osman

Driving while intoxicated (DWI) is the act of operating an automobile or other vehicle while under the influence of alcohol or other drugs. Driving while intoxicated is a serious crime in many countries throughout the world. Thousands of people are injured or killed every year in accidents involving alcohol. Penalties for driving while intoxicated include fines, imprisonment, and the suspension or *revocation* (taking away) of a person's driver's license. Some offenders are assigned to alcohol or drug abuse treatment programs. Other terms for driving while intoxicated include *driving under the influence* (DUI) and *drunk* or *drunken driving.*

Intoxication typically causes people to lose the ability to drive safely and alertly. Intoxicated drivers may experience blurred vision, delayed reactions, and reduced hand-eye coordination. Intoxicated drivers are also more likely to make bad decisions and to take unnecessary risks. Police officers stop and question drivers who appear to be intoxicated.

One of the main methods for measuring intoxication is to test the driver's *blood alcohol content* (BAC)—that is, the percentage of alcohol in the person's bloodstream. This percentage is also called *blood alcohol concentration.* Laws regarding BAC limits for drivers vary from country to country. Limits typically range from about 0.05 percent to about 0.10 percent. Other methods for measuring intoxication include *field sobriety tests.* During these tests, the driver may be asked to perform certain tasks, such as walking a straight line or balancing on one leg, in front of a police officer. Don Kenkel

See also **Automobile** (Driving safely).

Dromedary, *DRAHM uh DEHR ee,* also called *Arabian camel,* is a swift camel used mainly for transportation

and food in dry parts of India, the Middle East, and Africa. It sometimes grows to be 7 feet (2 meters) tall. The dromedary has only one hump. It can live on small amounts of food and water and has great endurance for desert travel. The dromedary has a swinging pace and can travel at a rate of about 10 miles (16 kilometers) an hour. It can cover 100 miles (160 kilometers) in a day. It produces rich milk, and its hair is used for cloth. No true wild dromedaries exist. See also **Camel**.

Scientific classification. The dromedary belongs to the camel family, Camelidae. It is *Camelus dromedarius*.

Anne Innis Dagg

Drought, *drowt,* is a condition that results when the average rainfall for an area drops far below the normal amount for a long period of time. This condition is also called *drouth* (pronounced *drowth*).

In areas that are not irrigated, the lack of rain causes farm crops to wither and die. Higher than normal temperatures usually accompany periods of drought. These high temperatures increase the stresses on plants and add to the crop damage. Forest and grass fires are more frequent and spread quickly due to the dry conditions. Much valuable timberland and rangeland has been burned during major droughts. Poor management of the soil can often lead to wind erosion. Often the dry and crumbled topsoil is blown away by hot, dry winds (see **Dust storm**). Streams, ponds, and wells often dry up during a drought, and animals suffer and may even die because of the lack of water. Water supplies for agricultural, industrial, and personal uses are greatly reduced during droughts. Water resource managers may impose water rationing to deal with such shortages.

Long-range weather forecasters cannot predict with certainty just when a drought will occur. But people who study climate conditions have discovered that these drier-than-normal periods tend to alternate with wetter-than-normal periods in an irregular cycle. Droughts of the past show in the rings that are made by trees as they add wood each year. In wet periods, the year's layer of wood is thick. In dry periods, the ring is thin (see **Tree** [illustration: How a tree reveals its history]).

The Great Plains region of the United States suffered one of the worst droughts in its history from 1931 to 1938, and the effects were felt throughout the entire country. Few food crops could be grown, food became scarce, and prices went up. Hundreds of families in the Dust Bowl area had to be moved to farms in other locations with the help of the federal government (see **Dust Bowl**).

From 1950 to 1954, the Southwest and the southern Great Plains suffered a severe drought. Hundreds of cattle ranchers were forced to ship their cattle to pasturelands in other regions of the country. To help ease this hardship, the federal government offered farmers emergency credit and seed grains at low prices. The worst drought since the 1930's struck the Midwest, northern Great Plains, and parts of the Southeast in 1988. It caused serious damage to grain crops.

Droughts have occurred in other areas of the United States and in other countries. In the early 1960's, a drought affected the Northeastern United States for several years, and from 1975 to 1977, a lack of winter snowfall resulted in severe drought conditions in the Western United States. Unusually dry conditions prevailed over western Europe from the fall of 1975 to the summer of 1976. Since the late 1960's, droughts have caused much suffering in Africa. The hardest-hit areas include Ethiopia and the Sahel, which lies south of the Sahara, Africa's great desert.

John A. Harrington, Jr.

Drowning is death caused by suffocation in water or other liquid. Most drownings and near-drownings happen in water to people who did not intend to enter the water, such as people who go boating. Falling into cold water is particularly dangerous. A person who becomes submerged in cold water can be quickly overcome by extremes of cold. Even shallow water can be a danger. Children have drowned in wading pools and even in bathtubs. In the United States, several thousand people drown each year.

Drowning begins when water or other liquid is inhaled into the lungs. This can happen when a person is gasping for air while struggling to stay afloat. When water enters the airway that leads to the lungs, the muscles of the larynx contract, preventing more fluid from entering. However, the muscular contractions also prevent air from reaching the lungs. Without air, the victim stops breathing, loses consciousness, and, unless rescued, dies.

A person who cannot swim can keep from drowning by floating upon the surface of the water. Both swimmers and nonswimmers can learn effective floating techniques—often called *survival floating*—in swimming and water safety classes.

Methods of rescue. Only a person trained in water rescues should swim out to help a drowning person. Many rescuers are pulled underwater by struggling victims.

If the drowning person is close enough, reach out with a fishing pole, an oar, a tree branch, a belt, or a shirt or towel. Keep your body low to avoid being pulled into the water. If no such objects are near, firmly grasp a secure object, such as a pool ladder, and extend an arm or leg to the victim. If the person is too far to reach, throw a ring buoy or other floating object—such as a styrofoam cooler—that the victim can grab and use to stay afloat. If the object is attached to a rope, throw it beyond the victim and pull it back within the victim's reach. Slowly pull the victim to safety.

Wade in to help the victim only if there is no danger from currents, objects on the bottom, or a sudden drop in the bottom. If possible, carry an item that will float, such as a cushion, raft, kickboard, or life jacket. Allow the victim to grasp one side of the object and pull the victim to safety, or allow the victim to grab the object and kick to safety. The object should always be kept between the rescuer and victim to prevent a panicky victim from pulling the rescuer under.

Giving first aid. If the rescued victim has stopped breathing, he or she should receive artificial respiration, also called *rescue breathing,* as soon as possible. The person administering artificial respiration must not give up quickly. People who have been submerged in extremely cold water for over an hour have been saved by artificial respiration. See **First aid** (Giving artificial respiration).

Critically reviewed by the American Red Cross

See also **Safety** (In water sports); **Swimming** (Water safety).

Capsules

Transdermal patch

Injectable drug

Tablets

Gel and cream

WORLD BOOK photos by Larry McCann

Liquid and inhalant

Modern drugs come in many forms and are administered in various ways. Most drugs are given orally. Drugs also may be applied to the skin, injected, or inhaled. Certain drugs may be obtained only with a doctor's prescription. Others may be purchased without a prescription.

Drug

Drug is one of the medical profession's most valuable tools. Doctors prescribe drugs to treat or prevent many diseases. Every year, penicillin and other germ-killing drugs save the lives of countless victims of meningitis, pneumonia, and other dangerous infectious diseases. Vaccines prevent such diseases as measles, polio, and smallpox. Analgesics lessen or eliminate pain. The use of these and many other kinds of drugs has helped millions of people live longer, healthier lives than would otherwise have been possible.

Most of our useful drugs were unknown before the 1900's. For example, the sulfa drugs and antibiotics, our best germ-fighting drugs, did not come into use until the late 1930's and early 1940's. Before that time, about 30 percent of all pneumonia victims in the United States died of the disease. The new drugs quickly reduced the death rate from pneumonia in the United States to less than 5 percent.

Polio vaccine was introduced in 1955. At that time, polio virus infected about 30,000 to 50,000 people every year in the United States. By 1960, use of the vaccine had reduced the number of new polio cases in the United States to about 3,000 a year. In 1900, most Americans did not live past the age of 47. Today, Americans live an average of more than 70 years, in part because of the use of modern drugs.

But drugs can also cause sickness and death. Any drug, even a relatively safe one, may cause harm if it is used improperly. Aspirin, for example, is one of the safest and most useful drugs. Yet every year, aspirin kills children who mistake the tablets for candy and eat too many of them. Any drug can kill if it is taken in a large enough dose. In addition, the widespread misuse of alcohol, cocaine, heroin, and other addictive drugs has become a serious problem.

We generally use the word *drugs* to mean only medicines and certain other chemical substances that people use, such as alcohol or marijuana. But *pharmacologists,* the scientists who study drugs, consider all chemicals that affect living things to be drugs. For example, they classify insecticides, weedkillers, and a wide variety of other substances as drugs. Even the chemicals in automobile exhaust and other substances that pollute the environment act like drugs because they affect living things.

This article deals primarily with drugs that are used for medical purposes. Detailed information dealing with the misuse of drugs can be found in the article **Drug abuse.**

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The many kinds of drugs people use can be classified in several ways. They can be grouped according to their form, such as a solid, gas, or liquid. Or they can be classified according to the way they are taken, such as by swallowing, inhaling, or injection. Drugs can also be grouped according to their chemical structure.

Pharmacologists generally classify drugs according to the major beneficial effect they have on the body. Many of the most widely used drugs belong to one of several dozen groups. Four especially important groups are (1) drugs that fight infection, (2) drugs that prevent infectious diseases, (3) drugs that affect the heart and blood vessels, and (4) drugs that affect the nervous system.

All drugs affect the body in more than one way. For example, some drugs taken to act on the nervous system also affect the heart. The action of these drugs on the heart is considered a *side effect.* The drugs discussed in this section, however, are classified according to their chief effect on the body.

Drugs that fight infection

Drugs that kill or help prevent multiplication of bacteria or viruses that infect the body are called *antimicrobials.* Antimicrobials that act against bacteria include *antibiotics* and *sulfonamides* (sulfa drugs). Antibiotics are obtained from naturally occurring microorganisms. Sulfonamides are prepared synthetically. A large dose of penicillin or certain other antibiotics kills disease-causing bacteria. A smaller dose of such an antibiotic keeps the bacteria from multiplying in the body and thus allows the body's natural defenses to destroy them. Sulfonamides also prevent bacteria from multiplying in the body. In most cases, however, sulfonamides and other synthetic antimicrobials do not kill the bacteria. See **Antibiotic; Sulfa drug.**

Doctors prescribe antiviral drugs to treat certain diseases caused by viruses. For example, the antiviral drug zidovudine, commonly called AZT, is used in the treatment of AIDS.

Drugs that prevent infectious diseases

Two kinds of drugs prevent infectious diseases. They are (1) vaccines and (2) antiserums and globulins. Some of these drugs, such as polio vaccines, are especially valuable because there is no effective treatment for the disease they prevent.

Vaccines contain a weakened or killed form of the microbe that causes a particular disease. There are several kinds of vaccines. Each kind causes the body to produce substances, which are called *antibodies,* that fight a particular disease. The vaccine thus makes the body *immune* to the disease by providing resistance against attack by it. Vaccines have been developed against such infectious diseases as cholera, diphtheria, hepatitis, measles, and smallpox, as well as polio. In fact, vaccinations against smallpox have wiped out that disease. See **Immunization.**

Antiserums and globulins, like vaccines, prevent certain infectious diseases. But unlike vaccines, these drugs contain antibodies rather than substances that cause the body to produce antibodies. The antiserums and globulins act more quickly than vaccines to prevent infection but give only temporary protection. Physicians prescribe these drugs after a person who has not been vaccinated is exposed to an infectious disease. Antiserums are used against such diseases as diphtheria and *tetanus* (lockjaw). Examples of diseases against which globulins protect include hepatitis, rabies, and tetanus. See **Serum; Globulin.**

Drugs that affect the heart and blood vessels

Drugs that affect the heart and blood vessels are known as *cardiovascular drugs.* Doctors prescribe them in treating diseases of the heart and blood vessels. Such diseases rank as the chief cause of death from disease in the United States, Canada, and many other countries. There are four major kinds of cardiovascular drugs: (1) antiarrhythmics, (2) cardiotonics, (3) vasodilators, and (4) antihypertensives.

Antiarrhythmics steady the heartbeat. People take these drugs to treat *tachycardia* and *fibrillation,* conditions in which the heart beats irregularly and at a rate much faster than normal.

Cardiotonics strengthen the heartbeat. These drugs cause the heart to beat more forcefully and thus increase circulation of the blood. Physicians prescribe them to treat conditions in which the heart pumps too weakly. The most widely used cardiotonic drugs are digoxin and digitoxin.

Vasodilators enlarge, or *dilate,* small blood vessels. These drugs are taken mostly to treat narrowing of the coronary arteries, the vessels that supply blood to the heart muscle. Drugs used to enlarge these arteries are called *coronary vasodilators.* Doctors prescribe them for people with such severe narrowing of the coronary arteries that they suffer chest pains while walking or exercising in some other way. Such persons are said to have

Rules for using drugs

No drug is absolutely safe. Proper use is beneficial. Improper use is harmful.

1. **Do not take a drug prescribed for someone else.** Only a physician or dentist can determine which drug will help you. A drug that works for someone else may not work for you.
2. **Do not save prescription drugs for later use.** Obtain a new prescription each time illness occurs. You may have an illness that seems the same as an earlier one but is actually different.
3. **Do not keep nonprescription drugs too long.** All drugs change chemically in time. Some become weaker than intended and others stronger. If a drug label does not tell how long a drug will remain safe and effective, ask your pharmacist.
4. **Follow all instructions on drug labels.** The label tells how much of a drug to take and how often. It also tells under what conditions you should not take the drug. It may be dangerous to use more of a drug than the amount prescribed or recommended, or to ignore any other label instructions.
5. **Report unpleasant or unexpected drug effects** to your physician or dentist. Any drug may produce an unusual, unexpected effect.
6. **Keep all drugs in a safe place** away from children and pets. An overdose of any drug can cause sickness or even death.

angina pectoris. The most widely used coronary vasodilators are isosorbide dinitrate and nitroglycerin. Other kinds of drugs used in treating angina include calcium channel blockers and beta-blockers.

Antihypertensives are used in the treatment of *hypertension* (high blood pressure). Vasodilators and many other kinds of drugs are antihypertensives. Vasodilators lower blood pressure by causing the muscles in the walls of small blood vessels to relax. The blood is then able to flow at a lower pressure. Other antihypertensives act differently. Often, two or more kinds are given daily to the same patient.

Other cardiovascular drugs. *Antihyperlipidemics* are drugs that lower levels of cholesterol and other blood *lipids* (fats) in the treatment of atherosclerosis. They include lovastatin, gemfibrozil, and pravastatin. *Anticoagulants,* such as heparin and warfarin, help prevent blood clotting. *Thrombolytics* are used to break up blood clots. They are especially useful in treating clots that form in the coronary arteries and can cause heart attacks. Widely used thrombolytics include tissue plasminogen activator and streptokinase.

Drugs that affect the nervous system

Many of the most widely used drugs affect the brain and other parts of the nervous system. These drugs include alcohol; the caffeine in cocoa, coffee, and tea; cocaine; marijuana; narcotics; and sleeping pills. Altogether, five major kinds of drugs affect the nervous system: (1) analgesics, (2) anesthetics, (3) hallucinogens, (4) stimulants, and (5) antianxiety and hypnotic drugs.

Analgesics relieve pain without causing unconsciousness or diminishing the other senses, such as the sense of touch or taste. For example, an analgesic may relieve a person's headache, but it will not prevent that person from feeling heat or cold or from tasting food.

There are two main kinds of analgesics: (1) narcotics (also known as opioid analgesics) and (2) nonnarcotics. Both kinds relieve pain. But narcotics also produce drowsiness, a dazed condition, and often a feeling of well-being. Aspirin and acetaminophen are two commonly used nonnarcotic analgesics. Widely used narcotics include codeine and morphine, both prepared from the opium poppy plant.

When pain is severe, physicians often prescribe a narcotic. For example, morphine is used to relieve the pain of severe injury and of cancer. But excessive use of narcotics leads to drug addiction, a condition in which a person has become so dependent on the drug that illness results if use of the drug is stopped. For this reason, physicians prescribe narcotics only if other analgesics will not work. See **Narcotic.**

Anesthetics eliminate sensation. *General anesthetics* eliminate sensation throughout the body, thus causing unconsciousness. These drugs, which include enflurane, halothane, and thiopental, are given during many kinds of surgical operations. *Local anesthetics* deaden the senses only in the area of the body to which they are applied. Dentists often give such local anesthetics as lidocaine and procainelike agents. Doctors use local anesthetics for eye surgery and other operations that do not require the patient to be unconscious. See **Anesthesia.**

Hallucinogens cause a person to *hallucinate*—that is, to see, hear, or otherwise sense something that exists only in the mind. These drugs are also called *psychedelic* (mind-revealing) drugs. They affect the senses, emotions, and reasoning, and at higher doses they may cause states resembling mental illness. Hallucinogenic drugs include LSD, marijuana, mescaline, and PCP. Physicians have experimented with hallucinogens in treating mental illness. See **Hallucinogenic drug.**

Stimulants overcome sleepiness and tiredness. These drugs *stimulate,* or increase the activity of, the nervous system. Stimulants include caffeine, cocaine, and synthetic drugs known as *amphetamines.* Common names for amphetamines include "speed," "uppers," and "wakeups." Stimulants create a sense of well-being in most users, in addition to increasing mental and physical activity. However, many people become depressed and uneasy as the effects of the stimulants wear off. They may then take the drug again to feel better, and they thus become dependent on it. For this reason, doctors seldom prescribe stimulants for tiredness. See **Amphetamine; Stimulant.**

Antianxiety and hypnotic drugs reduce tension and worry by altering the nervous system. They include tranquilizers, sedatives, and alcohol.

Tranquilizers calm a person without causing much drowsiness if taken in a small enough dose. Larger doses may make the user sleepy as well as calmer. However, even the use of mild tranquilizers over a long period of time may make the user dependent on these drugs. Psychiatrists prescribe *antipsychotic drugs* (sometimes called *major tranquilizers*) and *antidepressant drugs* for people who have severe mental disorders. These drugs may reduce a patient's extreme fears, worries, and distortions of thought. See **Tranquilizer.**

Sedatives, like tranquilizers, have a calming effect. But sedatives have greater ability than tranquilizers to make a person sleepy. As a result, physicians generally prescribe sedatives for patients who suffer from *insomnia* (the inability to sleep naturally). Barbiturates, also known as "barbs," "downers," and "goofballs," were once used widely as antianxiety drugs and sedatives. But because they are very habit-forming and lead easily to abuse, they have been largely replaced by safer drugs. The class of drugs known as *benzodiazepines* are now the most widely used tranquilizers and sedatives. These drugs include diazepam (for example, Valium) and triazolam (Halcion).

Alcohol is the common name for ethyl alcohol, the drug found in alcoholic drinks. It relaxes most people and makes them drowsy. The use of alcohol, like the use of most other drugs that depress the nervous system, may make a person dependent on it. See **Alcoholism.**

Other kinds of drugs

People also use many other kinds of drugs besides those discussed above. These drugs include (1) diuretics, (2) hormones, (3) vitamins, (4) antitumor drugs, and (5) immunosuppressive drugs.

Diuretics increase the formation of urine. In certain diseases, the kidneys do not produce enough urine. As a result, fluid, salts, and wastes build up in the body. Diuretics correct this condition by causing the kidneys to produce more urine. Diuretics are also used to treat hypertension. See **Diuretic.**

Hormones are chemicals made by the body's glands.

The hormones control many body functions, such as growth and reproduction. Certain animal hormones are similar to those produced by people, and scientists have created synthetic hormones. Natural and synthetic hormones are used as drugs in several ways.

Physicians prescribe hormones for patients whose glands produce insufficient amounts. For example, some people who have the disease diabetes mellitus do not produce enough of the hormone insulin. They must receive insulin injections. Doctors also prescribe hormones to treat diseases that do not result from a hormone deficiency. The hormones ACTH and cortisol, for example, are used in treating rheumatoid arthritis.

Hormones are also used as *oral contraceptives,* or *birth control pills,* which prevent pregnancy. These drugs work by interfering with the normal reproductive processes in a woman's body. See **Hormone; Birth control** (Methods of birth control).

Vitamins are essential to good health. Such diseases as rickets or scurvy develop if a person has certain vitamin deficiencies. The best way for a person to obtain vitamins is to eat a well-balanced diet. But if necessary, a physician may prescribe vitamin pills or injections. See **Vitamin.**

Antitumor drugs destroy cancer cells. Although many such drugs have been developed, they all injure normal cells as well as cancer cells. But some antitumor drugs have been used to lengthen the life of patients with incurable cancer. Scientists hope to develop drugs that will destroy only cancer cells.

Immunosuppressive drugs. If foreign proteins somehow get into the bloodstream, they act as *antigens,* causing white blood cells to make antibodies against them (see **Immune system**). This process also occurs when an organ from one person is transplanted into another person. The antibodies formed begin to destroy the transplanted organ. Immunosuppressive drugs interfere with the body's formation of antibodies.

One use of immunosuppressive drugs is to prevent the destruction and rejection of transplanted organs. Azathioprine and cyclosporine are examples of immunosuppressive drugs.

How drugs work

Different drugs are *administered* (given) in different ways. But once in the body, almost all drugs work the same way—by altering the speed of cell activities.

Entrance into the body. Most drugs are administered orally. But drugs may also be given in several other ways. For example, they may be injected, inhaled, or applied to the skin. The method of administration depends on the form and purpose of a drug. An anesthetic gas, for example, must be inhaled to produce unconsciousness. Ointments are applied directly to the area being treated.

Each method of administration has advantages and disadvantages. For example, the easiest and safest way to take a drug is by swallowing it. But some drugs cannot be taken orally because stomach juices destroy them. Injected drugs act quickly in the body. But injection is somewhat painful, and it presents greater risk of infection than do other methods of administration.

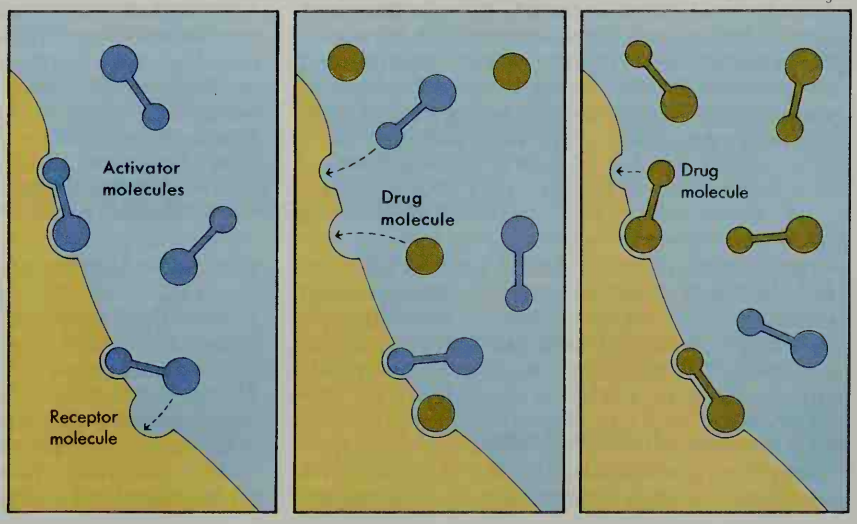
Researchers are constantly developing new methods of administration. A device called a *transdermal patch* contains a layer of medication and is attached to the skin like a bandage. The patch slowly and continuously releases the drug, which seeps through the skin to the bloodstream. The coronary vasodilator nitroglycerin may be administered in this way. Another device, the *implantable pump,* consists of a small, metal disk with a chamber that can be filled with a drug. The pump is inserted in the body surgically and delivers the medication continuously. It may be refilled by injection.

Action in the body. Most drugs that are swallowed, inhaled, or injected enter the bloodstream and travel throughout the body. They pass from the blood into the cells of the tissues where the drug action occurs. Only a few kinds of drugs—such as eye drops, local anesthet-

WORLD BOOK diagram

How the receptor theory explains drug action

According to the receptor theory, drugs produce their effects by attaching to *receptor molecules* in body cells. Normally, *activator molecules* produced in the body attach to a receptor molecule, *near right.* This chemical reaction causes a particular cell activity to speed up or slow down. Some drugs attach to a part of the receptor and thus keep the activator from forming a complete attachment, *center.* As a result, the particular cell activity is blocked. Other drugs are so similar to the activator that they form complete attachments themselves, *far right.* In such cases, the cell activity increases.



ics, and nasal sprays—act before entering the bloodstream. When these drugs eventually enter the blood, the amount is usually too small to produce additional effects on the cells.

Almost all drugs create their effects by altering cell activities. To explain how drugs act on cells, pharmacologists developed the *receptor theory.* According to this theory, chemical reactions in every living cell control the cell's activities. Each controlling reaction causes a particular cell activity to begin, to speed up, or to slow down. A drug acts on a cell by altering one or more of these chemical reactions. It does so by attaching to *receptor molecules* in each cell that are normally involved in the controlling chemical reaction.

The receptor theory not only explains how drugs work, but it also points up what drugs can and cannot do. Because they react with receptors that control cell activities, drugs can only alter the speed of those activities. They cannot create new cell activities.

In most cases, the chemical reaction between a drug and the body is not a one-way process. Drugs alter cell activity, but normal body processes also change most drugs. These processes transform a drug into one or more new substances, most of which are weaker than the original drug. This changing of drugs is called *biotransformation* or *drug metabolism.* It is one way in which the body protects itself against drugs. Most biotransformation occurs in the liver. A diseased liver takes longer than a healthy liver to change a drug into a weaker substance. As a result, physicians generally reduce drug dosage for a patient with liver disease. Otherwise, the drug would last longer in the body and thus exert too great an effect.

Effect on the body. All drugs can affect the body in both helpful and harmful ways. For example, a particular drug may produce a stronger heartbeat, relief from pain, or some other desired effect. But that drug, like all drugs, can also cause undesired effects—especially if the dose is too large.

Most drugs produce changes throughout the body because the drugs circulate through the bloodstream. As a result, most drugs used to affect one part of the body also affect other parts. For example, physicians sometimes prescribe morphine to relieve pain. Morphine alters the activities of cells in the brain and spinal cord and thus reduces the sensation of pain. But morphine also alters the function of cells in the body that are not involved in sensing pain. It may decrease the rate of breathing, cause vomiting, produce constipation, and create other undesired effects.

In general, a drug's effects are strengthened as the dose is increased and weakened as the dose is decreased. But all people do not react the same to a change in the dose of a drug. Doubling the dose, for example, may triple the strength of the drug effects in one person and not increase the effects in someone else.

The section *Kinds of drugs* describes the chief desired effects of various drugs. Effects other than those desired are called *adverse reactions.* Drugs produce three main kinds of adverse reactions: (1) side reactions, (2) hypersensitivity reactions, and (3) toxic reactions. The repeated use of alcohol, narcotics, and certain other drugs may create a condition called *drug dependence.*

Side reactions, or side effects, occur with all drugs. Physicians can anticipate these reactions and tell a patient what to expect. For example, many of morphine's harmful effects are side reactions and should therefore be expected. Most drugs cause weak side reactions that do not prevent use of the drug.

Hypersensitivity reactions, also called *allergic reactions,* occur only in persons allergic to a particular drug. Some of these reactions are minor but others are severe. Any drug may cause an allergic reaction in people highly sensitive to that drug. Some people cannot take such common drugs as aspirin or penicillin because they are allergic to them.

Toxic reactions result from drug poisoning. Such reactions damage cells and may kill a person. All drugs can have a mild toxic effect, and a large enough overdose of any drug will produce a severe toxic reaction.

Drug dependence. People who repeatedly take large amounts of such drugs as alcohol, amphetamines, barbiturates, or narcotics may become dependent on the drugs. These people have an intense psychological or physical need for a drug's effects. *Tolerance,* or resistance to a drug's effects, usually develops along with drug dependence. As drug use continues, tolerance increases. The drug user must thus take larger and larger doses to obtain the desired effects. The development of physical or psychological dependence, or both, is commonly called *drug addiction.* In most cases, a severe withdrawal illness occurs if a person stops taking the drug. See **Drug abuse**.

Elimination from the body. The body eliminates drugs with other waste materials. Most drugs travel from the cells through the bloodstream to the kidneys and are eliminated in the urine. The body also eliminates drugs in sweat, tears, and solid wastes. Some anesthetics are eliminated almost entirely in exhaled breath.

How drugs are produced and sold

The production and sale of drugs used as medicines is a big business in many countries. The world's leading producers include France, Germany, Japan, Switzerland, the United Kingdom, and the United States. This section deals chiefly with the production and sale of drugs in the United States.

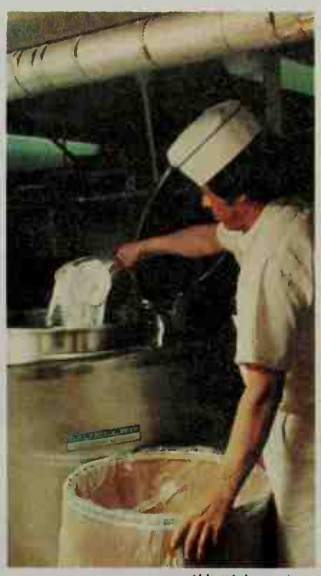
Sources of drugs

The drug, or *pharmaceutical,* industry produces mostly synthetic drugs. Chemists working in the laboratories of drug companies create these drugs from chemical elements. Other drugs produced by the pharmaceutical industry are obtained from plants, molds, animals, minerals, and genes and bacteria.

Chemical laboratories. Chemists have created many of our most valuable medicines. Most of these drugs do not occur naturally. Synthetic drugs duplicate or improve upon those obtained from plants, molds, bacteria, animals, or minerals. Pharmaceutical companies can produce many of these drugs at less cost and in greater

Abbott Laboratories (WORLD BOOK photo)

Nancy Palmer Photo Agency Inc.



Abbott Laboratories (WORLD BOOK photo)

Some sources of drugs. Most drugs are synthetic compounds created in drug company laboratories, *left.* Other drugs come from plants, animals, minerals, and bacteria. For example, opium poppies, *center,* supply opium, used to make such narcotics as codeine and morphine. Sodium chloride, or salt, and other substances are used in preparing *intravenous solutions, right,* which are injected into the veins of patients who cannot eat or drink.

quantity synthetically than by using the natural source. For example, the hormone cortisol, used to treat arthritis and many other ailments, can be obtained from the adrenal glands of cows and sheep. But drug companies can produce it cheaper synthetically. In addition, the synthetic form of cortisol causes fewer adverse reactions than the natural form of the hormone.

Plants and molds. Drug companies make several important medicines from plants and molds. These medicines include antibiotics, cardiotonics, and certain analgesics. For example, the antibiotic penicillin comes from a mold. The cardiotonic digitalis, a drug used to stimulate the heart, is obtained from the leaves of the purple foxglove, a flower. The pain reliever morphine is taken from opium, a drug that comes from the juice of the opium poppy. Plant drugs that pharmaceutical companies do not produce include such illegal drugs as marijuana and mescaline.

Animals. A number of important drugs—including several of the hormones used to treat arthritis, hormone deficiencies, and various other ailments—are obtained from the cells and tissues of animals. For example, millions of diabetes victims use insulin obtained from the pancreas of cattle and hogs. Physicians prescribe the hormone thyroxine, obtained from the thyroid gland of cattle and hogs, for patients whose thyroid gland produces too little of the hormone.

Minerals. Pharmaceutical companies produce several common drugs from minerals. For example, the mineral iodine is used in making tincture of iodine, a liquid that helps prevent infection when applied to cuts.

Genes and bacteria. Biologists and chemists have developed methods of genetic engineering by which human genes are inserted into bacterial cells or, occasionally, animal cells. The genetically altered bacterial or animal cells manufacture a chemical substance identical to one that is made by human cells. The substance is then isolated and purified so it can be administered to patients whose bodies cannot make enough of it. Examples of drugs produced in this way include erythropoietin, a hormone that stimulates production of red blood cells; tissue plasminogen activator, a protein that dissolves blood clots and can stop a heart attack; and insulin, a hormone that controls the disease diabetes. See **Genetic engineering.**

Research and development

Pharmaceutical firms are continually developing new drugs. Although company chemists discover some new drugs by accident, the creation of most new products begins with an idea. This idea may be for a new kind of drug or for one that works better than existing drugs. A pharmaceutical company must then obtain such a drug, test it, and develop it into a safe, easy-to-use form. The entire process takes on average about 14 years and costs many millions of dollars.

Creating a new drug is the task of a company's research chemists. They may make a new chemical compound or obtain the drug from a natural source. This work may take many months or even years. For example, researchers for one United States drug company spent two years testing soil from all parts of the world to find new antibiotics. The tests involved over 100,000 soil samples. The project resulted in the development of the antibiotic Terramycin, used to treat such diseases as bronchitis, pneumonia, and whooping cough.

In the process of creating a new drug, researchers perform tests with animals to see if the substance is safe and effective. They first give the substance to small animals, such as rats, mice, and guinea pigs. If the sub-

stance passes these tests, it is given to larger animals, such as dogs and monkeys. Researchers may test hundreds of substances before finding one that appears safe and effective. They then try to find out how this drug works, in what forms it can be given, how the animal body eliminates the drug, and what side effects it may have. The drug company then sends this and other information about the drug to the U.S. Food and Drug Administration (FDA)—a U.S. government agency—and asks for permission to conduct tests on people.

Testing with people. After receiving FDA approval, a drug company performs two series of *clinical tests* with the new drug. The company first tests the drug for safety in healthy human volunteers. If the results of these tests are satisfactory, the company checks the drug further in patients who have the disorder the drug is designed to correct.

Most clinical tests are supervised by a *clinical investigator,* a physician employed by the drug firm's research department. Physicians on university hospital staffs cooperate with the clinical investigator by arranging for volunteers to take part in the second series of tests. The number of patients who get the drug and the length of the tests depend on the disorder and the drug being tested. Most tests involve hundreds of patients and last from several months to a year. Some tests, however, involve thousands of patients and last several years.

Careful testing is one of a pharmaceutical company's most important responsibilities. Drug companies and the FDA constantly guard against the possibility of a harmful drug being sold to the public. But even the most careful testing cannot always reveal the possibility that a drug might produce an unexpected harmful effect. A tragic example of such an unexpected effect occurred in Europe during the early 1960's. Thousands of pregnant women who took a new sedative, thalidomide, gave birth to babies with no arms or legs or with some other deformities. The chances of such severe effects occurring unexpectedly are, however, very small.

The drug company's clinical investigator and other scientists evaluate the results of the clinical tests. They also compare the new drug with those already in use. Other physicians and scientists continue to study the effects of the drug in animals. If the company decides it has developed a safe, effective drug, it will submit a *new drug application (NDA)* to the FDA requesting approval to sell the drug. The section *The new drug application* describes this step in drug production.

Developing the finished product. Before selling a new drug, a company must develop it into a safe, easy-to-use form. Researchers determine what ingredients to add to the drug to make it into a capsule, liquid, tablet, or other usable form. These ingredients, called *excipients,* must not interfere with the drug's action. Researchers also determine how fast the drug will break down chemically and lose its effectiveness. The company can include this information on the label if the breakdown occurs quickly. After all these steps, the company is ready to plan mass production of the drug.

Mass production

During research and development, a company produces only small quantities of a drug. The firm must determine whether the process used to produce small amounts will work for large-scale production. The company usually conducts production tests in an experimental *pilot plant* before beginning mass production. These production tests may indicate that small-scale methods must be changed. Sometimes these tests indicate that a new plant must be built to produce the drug.

A company has to plan its mass-production schedule carefully. If the firm produces too much of a drug, some of it might break down chemically and become worthless before it is sold. The company must also make certain that all batches of the drug have been made correctly. Samples of each batch are inspected. If such spot-checking reveals an error, the entire batch is either processed again or destroyed.

Distribution and sale

A new drug may be distributed and sold in one of two ways, depending on whether it is a prescription drug or a nonprescription drug. *Prescription drugs* may be sold only by a pharmacist and only if prescribed by a physician or dentist. *Nonprescription drugs* need not be sold by pharmacists and do not require a prescription. The FDA determines whether a drug may be sold as a prescription or nonprescription drug.

Prescription drugs include antibiotics, barbiturates, and certain tranquilizers. Because these drugs require a prescription, pharmaceutical companies direct their sales efforts for these drugs at physicians and dentists. The companies place advertisements in professional journals, mail out literature, and set up advertising displays at medical and dental meetings. Most drug firms also employ *medical service representatives* who call on doctors to tell them about the firm's products.

Nonprescription drugs, such as aspirin and some cough medicines, are considered safe enough to be sold *over the counter (OTC)*—that is, without a prescription from a physician or dentist. A drugstore, grocery store, department store, or any other establishment may sell such drugs. As a result, pharmaceutical firms advertise nonprescription drugs widely to the public.

Drug names

All drugs produced by the U.S. pharmaceutical industry are given at least two names: (1) a chemical name and (2) a United States Adopted Name (USAN). In addition, a drug may have one or more trade names, or trademarks. For example, a certain diuretic has the chemical name 6-chloro-3-4-dihydro-2H-1,2,4-benzothiadiazine-7-sulfonamide-1,1-dioxide. Its USAN is hydrochlorothiazide. The drug also has more than 20 trade names, including Esidrix, HydroDIURIL, and Oretic.

The chemical name of a drug describes its chemical structure. It is the only name that identifies a drug exactly. But because most drugs have long, difficult chemical names—such as the above example—these names are not commonly used.

The United States Adopted Name, commonly referred to as the *generic* name, is usually an abbreviated chemical name. It provides a hint about a drug's chemical structure, as the name *hydrochlorothiazide* does in the example. But the USAN does not describe a drug fully. The USAN is shorter than the chemical name and easier to use. The USAN Council, made up of pharmacists and scientists in other fields, selects all USAN's.

The trade name is given to a drug by the company that sells it. A number of firms may sell a particular drug. Each company may give the drug a different trade name, or it may market the drug under the drug's generic name. A drug may have 10, 20, or more trade names. State laws vary concerning prescriptions written for trade-named drugs. In some states, if a doctor prescribes a drug by its trade name, a pharmacist must fill the prescription with the trademarked drug. But in other states, a pharmacist may substitute a lower-priced trademarked or generic equivalent, as long as the doctor has not specifically prohibited such substitution. In still other states, a pharmacist may substitute an equivalent only if the doctor has indicated that such substitution is permissible. If a doctor prescribes a drug by its generic name, a pharmacist may fill the prescription with a suitable drug sold by any company.

Drug regulation

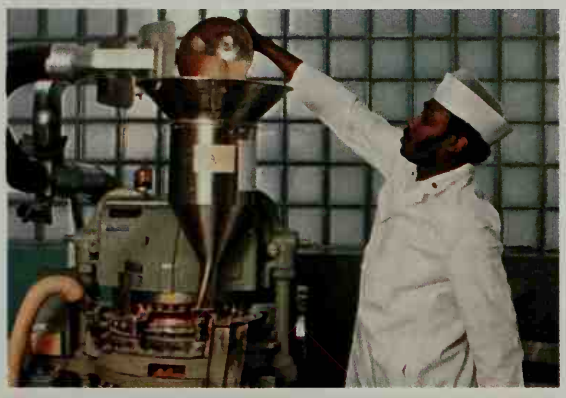
Almost all countries have laws regulating the manufacture, sale, and use of drugs. In the United States, every new drug that is sold must be approved by the FDA. In addition to approval of the drug, the FDA inspects factories that manufacture drugs, and it checks the quality of drug samples that are taken from stores.

The United States Drug Enforcement Administration works to end the illegal use of narcotics and other drugs of abuse (see **Drug Enforcement Administration**). In addition, many states have laws concerning the manufacture, sale, and use of drugs. In Canada, the manufacture and sale of drugs is regulated by the Health Protection Branch of the federal Department of National Health and Welfare.

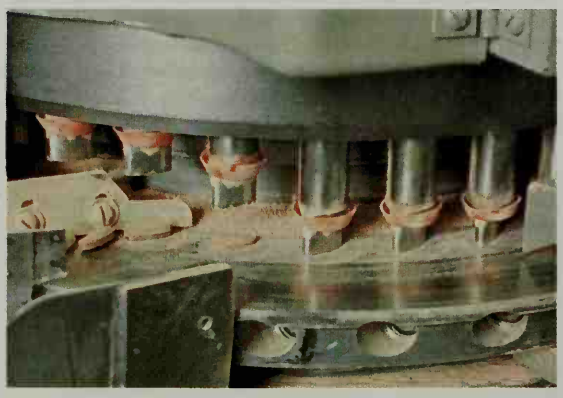
U.S. drug laws. The Federal Food, Drug, and Cosmetic Act of 1938 outlaws the sale of impure and falsely labeled drugs. It also requires manufacturers to prove to the FDA that a new drug is safe before they may sell it. In addition, the law requires that drug labels list active ingredients, directions for use, and warnings of possible harmful effects. Under the Drug Amendments Act of 1962, drug companies must prove that a new product is effective and safe. In 1975, the FDA issued regulations to ensure that all trade-named and generic equivalents of the same drug have identical actions in the body. In 1978, the FDA issued rules requiring that the labels of all prescription drugs and most nonprescription drugs carry an expiration date to show how long the drug will remain fully effective. The FDA controls advertising of

How a drug is mass-produced

Pharmaceutical companies manufacture drugs in a variety of forms, including capsules, liquids, and tablets. The pictures below show some of the steps in the mass production of tablets.



Drug powder poured into stamping machine



Machine stamps drug into tablet form

Tablets receive protective coating

Abbott Laboratories (WORLD BOOK photos)

Tablets bottled for distribution

prescription drugs. The Federal Trade Commission (FTC) controls advertising of nonprescription drugs.

The Comprehensive Drug Abuse Prevention and Control Act of 1970 strengthened federal regulation of the manufacture, sale, possession, and use of narcotics and other drugs of abuse. The act also called for increased federal assistance in the treatment of drug-dependent persons.

The Orphan Drug Act of 1983 encourages drug manufacturers in the United States to work with new drugs that can be used in the treatment of rare diseases. Such drugs are often referred to as *orphan drugs* because pharmaceutical firms cannot afford to develop them. Research and marketing costs would exceed income from sales of the drugs. The Orphan Drug Act includes regulations that help reduce the expenses of developing and marketing orphan drugs. In addition, the act provides federal grants to pay for some of the costs of research and development.

The Federal Anti-Tampering Act of 1983 prohibits tampering with containers or labels for foods, drugs, or cosmetics. The act's purpose is to prevent unintentional use of incorrectly labeled or contaminated products.

The new drug application. In seeking FDA approval to sell a new drug, a drug company must submit a new drug application (NDA). The application must contain detailed information about the drug, including four important items: (1) records of tests that prove the drug is both safe and effective, (2) an account of the drug's composition, (3) a description of the methods used to manufacture the drug, and (4) the information to be included on the drug label. The company must also provide the FDA with samples of the drug and its ingredients.

FDA scientists study each new drug application and conduct tests, if necessary, with the samples from the drug company. If they approve a drug, these scientists decide whether it will be sold as a prescription or nonprescription drug.

Drug standards. In the United States, standards of drug composition are established by *The United States Pharmacopeia-The National Formulary* (USP-NF). Federal law recognizes this publication as the official authority on drug standards. The USP-NF is revised continuously by a committee of the United States Pharmacopeial Convention. Each convention is attended by representatives from schools of medicine and pharmacy; from various federal agencies; and from associations of physicians, dentists, and pharmacists.

History

Prehistoric peoples probably used drugs long before civilizations arose. It is likely they discovered that aches and pains disappeared after eating certain plants. They may have also noticed that animals ate certain plants only when ill and then recovered. Prehistoric people probably then ate the same plants when they felt sick.

Drugs in ancient times. The oldest known written record of drug use is a clay tablet from the ancient Sumerian civilization of the Middle East. This tablet, made in the 2000's B.C., lists about a dozen drug prescriptions. An Egyptian scroll from about 1550 B.C. names more than 800 prescriptions containing about 700 drugs. The ancient Chinese, Greeks, and Romans also used many drugs. Most of the remedies were useless. Occasionally, people who had taken useless remedies recovered naturally. As a result, they thought the drugs were responsible. However, ancient peoples did discover some effective drugs. The Greeks and Romans, for example, used opium to relieve pain. The Egyptians used castor oil as a laxative.

Drugs in the Middle Ages. During the Middle Ages, which lasted from the A.D. 400's to the 1500's, interest in learning and science declined in Europe. As a result, Europeans produced little new information about drugs. But in the Middle East, Arab physicians added new discoveries to the knowledge of drugs they had acquired from the ancient Romans and Chinese. The Arabs later passed on their knowledge of drugs to Europeans.

Throughout the Middle Ages, the demand for drugs remained high, and pharmacies became increasingly common in Europe and the Arab world. But scientists had not yet learned how the human body functions, what causes infectious disease, or how drugs work. As a result, people continued to take many useless or harmful drugs, in addition to some effective ones.

Scientific advances. In the 1500's and 1600's, doctors and scientists made important advances in *pharmacology* (the study of drugs) and in other fields of science. These advances laid the foundation for later revolutionary progress in the development of drugs. In the early 1500's, Swiss physician Philippus Paracelsus pioneered in the use of minerals as drugs. He introduced many compounds of lead, mercury, and other minerals in the treatment of diseases. But further progress in the development of drugs required advances in knowledge of the structure and functioning of the human body.

In 1543, the Flemish physician Andreas Vesalius, known as the founder of human anatomy, published the first complete description of the body's structure. His work destroyed many false beliefs about human anatomy. In the early 1600's, the English physician William

Sumerian clay tablet; University Museums, University of Pennsylvania

The oldest written prescriptions ever found date from the 2000's B.C. They call mostly for various types of plant remedies.

Harvey discovered how blood—pumped by the heart—circulates through the body. Later in the 1600's, Anton van Leeuwenhoek, an amateur Dutch scientist, discovered bacteria. He used crude microscopes to study the tiny organisms. But the role of germs as a cause of disease was not established until the 1800's.

The drug revolution began about 1800 and has continued to the present. During this period, scientists have discovered hundreds of drugs. They have also discovered the cause of many diseases, determined how drugs work, and learned much about how the body functions. In the process, the practice of medicine has been revolutionized, in large part by the use of drugs. Pharmacology has developed into a major science, and the manufacture of drugs has become a large industry.

In 1796, Edward Jenner, an English physician, developed the first successful vaccination in an effort to prevent the deadly disease smallpox. He vaccinated a boy with pus from blisters on a woman infected with cowpox. The boy then caught cowpox, a minor disease related to smallpox. Jenner later injected smallpox matter into the boy. But the boy did not catch smallpox because his fight with cowpox had made his body *immune* (resistant) to smallpox. Jenner's discovery led to a search for vaccines against other diseases. This search gradually developed into the science of *immunology.*

Scientists learned how to *isolate* (separate) drugs from plants during the early 1800's. In 1806, morphine became the first of the plant drugs to be isolated. Within a few years, scientists had also isolated quinine.

In the 1840's, the use of anesthetics during surgery was introduced by two Americans working independently of each other—Crawford Long, a physician, and William T. G. Morton, a dentist. Later in the 1800's, the French scientist Louis Pasteur and the German physician Robert Koch established the *germ theory* of disease. Pasteur proved that germs cause infectious diseases and that killing the germs responsible stopped the spread of such diseases. Koch developed a method for determining which bacteria cause particular diseases.

The pace of the drug revolution quickened in the 1900's. In fact, most of the major drugs used today have been discovered since 1900. Important developments in hormone research followed the first isolation of a hormone in 1898. That year, an American pharmacologist, John J. Abel, isolated the hormone epinephrine, also called adrenalin. Scientists isolated several other hormones during the next 20 years. Then in the early 1920's, a research team led by Frederick Banting, a Canadian physician, discovered the hormone insulin. Since then, this drug has saved the lives of millions of diabetics.

In the early 1900's, Paul Ehrlich, a German scientist, developed a new method of treating infectious diseases. This method, called *chemotherapy,* involves the use of chemicals that attack disease-causing organisms. It is also used to destroy cancer cells. Ehrlich announced the discovery of the first chemotherapeutic drug, arsphenamine (Salvarsan), in 1910. His work led to the later discovery of the germ-fighting antibiotics and sulfa drugs.

The first antibiotic, penicillin, was discovered in 1928 by British scientist Alexander Fleming. A German physician, Gerhard Domagk, discovered the first sulfa drug, Prontosil, in 1935. Scientists soon developed other antibiotics and sulfa drugs. These "wonder drugs" were remarkably effective against many infectious diseases.

Many other important drugs have been discovered since 1900. Barbiturates, which reduce the activity of the nervous system and the muscles, were introduced in 1903. Amphetamines, which stimulate the nervous system, were first used medically in the early 1930's. Scientists developed several important tranquilizers in the 1950's, and birth control pills appeared in 1960. Scientists first used *recombinant DNA techniques* during the 1970's. These techniques involve inserting human genes into bacterial cells or, occasionally, animal cells, causing the cells to produce human proteins. In the 1980's, researchers applied recombinant DNA technology to produce large quantities of such drugs as insulin and interferon.

Scientists have also developed methods of using genetically identical cells to produce *monoclonal antibodies* that attack specific molecules. In addition, researchers are investigating gene therapy, using the nucleic acids DNA and RNA, to correct the way diseased cells work in the patient's own body.

Growth of the drug industry. Until about 1800, there were few drug companies. Pharmacists themselves made almost all the drugs they sold. Then two revolutions, one in drugs and the other in industrial development, gave birth to the modern drug industry. The discovery of more and more drugs that required special training and equipment to produce made it increasingly difficult for a pharmacist to prepare drugs. At the same time, the Industrial Revolution in Europe led to the development of manufacturing methods that could be used to mass-produce drugs. As a result, many drug companies were established in Europe, and European firms dominated the world drug market for many years.

The beginning of the United States drug industry can be traced back to the Revolutionary War in America (1775-1783). The chief pharmacist of the American army, Andrew Craigie, set up a laboratory in Carlisle, Pennsylvania, to supply drugs to the military. After the war, Craigie opened his own laboratory and began a wholesale drug business. Soon other pharmacists set up drug

Drug milestones of the 1900's

1903 The first barbiturate, barbital, was introduced.

1910 The German scientist Paul Ehrlich introduced *chemotherapy,* a method of treating infectious disease by using chemicals to attack the disease-causing bacteria.

1922 A research team led by Frederick Banting announced the discovery of the hormone insulin.

1928 The British scientist Alexander Fleming discovered the first antibiotic, penicillin.

1930's Amphetamines were first used medically.

1935 Gerhard Domagk, a German physician, discovered the first sulfa drug, Prontosil.

1950's Scientists developed several important synthetic tranquilizers, which came into widespread use.

1960 Birth control pills were introduced.

1970's Drug researchers intensified their efforts to find drugs that will help cure cancer and many other diseases. Recombinant DNA methods were developed.

1980's and 1990's Recombinant DNA methods were used commercially to produce interferons, insulin, and other protein-based drugs. Researchers developed therapies using monoclonal antibodies.

companies. These companies grew as they adopted the mass-production techniques developed in Europe.

The American Civil War (1861-1865)—like the Revolutionary War—created a great demand for drugs and so furthered the growth of the U.S. pharmaceutical industry. But European companies continued to dominate the world drug market until World War I (1914-1918). Before the war, the United States imported most of its drugs from Germany. But such imports stopped when the United States joined the war against Germany in 1917. The American pharmaceutical industry then expanded rapidly to meet the country's drug needs. The United States soon began to export drugs and became one of the world's leading producers. Today, the United States leads all countries in drug production.

Drugs today benefit us tremendously. They also present us with some of our worst problems and greatest challenges. Drugs help prevent or control many diseases. They relieve pain and tension and help the body function properly. But misuse of alcohol, narcotics, and other drugs has led to addiction for millions of people. In addition, widespread illegal use of drugs has become a major problem. The challenges that drugs offer lie in the discovery of better medicines for treating cancer, cardiovascular diseases, AIDS, and other crippling and deadly disorders. In the 1980's and 1990's, pharmaceutical researchers increased efforts to find such drugs. Someday, scientists may develop drugs that lengthen life by slowing the aging process. Robert J. Linhardt

Study aids

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Aceta-minophen	Beta-blocker	Ether	Morphine
	Bromide	Hallucino-genic drug	Narcotic
Alcohol	Caffeine		Nitrous oxide
Amphetamine	Chloroform	Hashish	Opiate
Analgesic	Chlorpro-mazine	Heroin	Opium
Anticonvulsant		Ibuprofen	Procaine
Antidepres-sant	Cinchona	Kola nut	Quinine
	Coca	Lidocaine	Reserpine
Aspirin	Cocaine	LSD	Ritalin
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Belladonna	Curare	Mescaline	Sedative
Benzocaine	DMSO	Methadone	Thiopental
Benzodi-azepine	Dramamine	Methampheta-mine	Tranquilizer
	Ecstasy		

Other kinds of drugs

ACTH	Camphor	Epinephrine
Antacid	Cascara sagrada	Eucalyptus
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Antihistamine	Coagulant	Inhalant
Antiseptic	Cortisone	Insulin
Antitoxin	Creosote	Interferon
Antiviral drug	Cyclosporine	Iodine
Arsenical	DES	Iron
BCG	Digitalis	Laetrile
Bronchodilator	Disulfiram	Laxative
Calcium channel blocker	Diuretic	Liniment
	Emetic	Magnesia
Psyllium	Squill	Taxol
Serum	Steroid	Thalidomide
Silver nitrate	Tamoxifen	Vitamin
Smelling salts		

Other related articles

Alternative medicine	Food and Drug Administration
Anaphylactic shock	Immunization
Anesthesia	Lethal injection
Antidote	Medicine
Birth control	Mental illness (Somatic therapy)
Brain (How drugs affect brain chemistry)	Microencapsulation
Chelation therapy	Pharmacy
Chemotherapy	Placebo
Depressant	Pure food and drug laws
Drug abuse	Stimulant
Drug Enforcement Administration	Transplant (Using immunosuppressive drugs)
Enzyme (Uses)	

Outline

I. Kinds of drugs
- A. Drugs that fight infection
- B. Drugs that prevent infectious diseases
- C. Drugs that affect the heart and blood vessels
- D. Drugs that affect the nervous system
- E. Other kinds of drugs

II. How drugs work
- A. Entrance into the body
- B. Action in the body
- C. Effect on the body
- D. Elimination from the body

III. How drugs are produced and sold
- A. Sources of drugs
- B. Research and development
- C. Mass production
- D. Distribution and sale
- E. Drug names
- F. Drug regulation

IV. History

Questions

What are six important rules for the use of drugs?
What kinds of adverse reactions do drugs produce?
How did scientific advances of the 1500's and 1600's affect later development of drugs?
How do prescription and nonprescription drugs differ?
How does the *receptor theory* explain drug action?
When was the first antibiotic discovered? The first sulfa drug?
How are new drugs tested for safety and effectiveness?
What government agency determines whether a drug may be sold in the United States?
How do scientists generally classify drugs?
What three kinds of names are given to drugs produced by the U.S. pharmaceutical industry?

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Drug abuse can devastate lives. Using hypodermic needles to inject drugs, as these teen-agers are doing, is especially dangerous. They risk infection with hepatitis or HIV, the virus that causes AIDS.

Drug abuse

Drug abuse is the nonmedical use of a drug that interferes with a healthy and productive life. Drug abuse occurs at all economic levels of society, from the wealthy to the impoverished, and among young people as well as adults. Any drug may be abused, including tobacco, alcohol, medications, and substances that give off intoxicating fumes. Drug abuse is often called *substance abuse* or *substance dependence,* which together are called *substance use disorders.*

Many young people begin to use drugs or alcohol to experiment with the pleasurable effects of drugs, to fit in with peers, or to try on adult roles and behaviors. Most people who experiment with drugs or alcohol do not become addicted. However, repeated use of nicotine, alcohol, and other drugs may lead to physiological and psychological dependence, commonly known as addiction. *Withdrawal* is the reaction of the body when regular drug use is stopped.

When a person becomes dependent, the drug becomes so rewarding that it may drive the user to continue taking it despite harmful medical or social consequences. Such consequences include poor motivation, impaired judgment and memory, personality changes, and disrupted family relationships. Drug abusers also may develop health problems, such as hepatitis, AIDS, and other serious medical consequences, even death.

Drug abuse patterns vary throughout the world. This article chiefly discusses the problem in industrialized nations, mainly in Europe, North America, and Australia.

Abuse of legal drugs

Some of the most commonly abused drugs can be purchased legally by adults. They include (1) alcoholic beverages, (2) tobacco products, (3) inhalants, and (4) prescription drugs.

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Alcoholic beverages are one of the most commonly abused drugs in the world. Alcohol is a *depressant* that decreases the activity of the central nervous system. It also interferes with thinking, concentration, judgment, and movement. Some people who repeatedly abuse alcohol develop a dependence on it. See **Alcoholism.**

Tobacco is among the most addictive drugs. Repeated use can rapidly lead to physiological and psychological dependence that is difficult to treat. The addictive element in tobacco products is *nicotine.* Nicotine is a *stimulant,* a chemical that excites the central nervous system. Nicotine addiction causes withdrawal symptoms when a person tries to stop smoking. When chronic smokers are deprived of cigarettes, they may feel more irritable and anxious. They may also experience craving for cigarettes. See **Smoking.**

Inhalants give off fumes that are inhaled for their intoxicating, mind-altering effects. They include glues, nail polish, gasoline, and aerosol sprays. Inhalants take the place of oxygen in the lungs, depleting the amount of oxygen available to the brain, creating an intoxicating effect. Inhalants can make the user feel relaxed, restless, uncoordinated, and sometimes delirious. Some fumes can cause lung, liver, and brain damage. They may also lead to heart failure, coma, and death, primarily due to oxygen depletion. See **Inhalant.**

Over-the-counter drugs that can be abused include cough and cold medications. Many of these medications contain such substances as alcohol or stimulants. Some herbal preparations that can be purchased legally at health food and grocery stores claim to increase alertness and energy. Some contain an herbal stimulant called *ephedra.* Athletes and other people sometimes abuse this substance in an attempt to increase mental or physical performance.

Prescription drugs can be obtained and used legally only when prescribed by a physician. Many prescription drugs have a high risk for abuse when taken in greater amounts than prescribed or when used by people for whom they are not prescribed. Commonly abused prescription drugs include stimulants called *amphetamines,* and *analgesics* (pain relievers), barbiturates, and tranquilizers. For more information, see the articles **Am-**

phetamine, Analgesic, Barbiturate, and Tranquilizer.

Steroids are a special type of prescription drug used medically for a variety of purposes. However, some athletes abuse *anabolic* (muscle-building) steroids to increase muscle size and strength. Abuse of steroids can cause aggressive behavior and serious mental disturbances, such as dramatic mood swings or psychosis. Steroid abuse can also lead to infertility, liver damage, and other serious medical problems.

Abuse of illegal drugs

In many countries, it is illegal to sell any drug, including alcohol and tobacco products, to children and adolescents. Many other drugs are illegal for both adults and minors—that is, under most circumstances their possession and sale are forbidden by law. Illegal drugs include (1) marijuana, (2) cocaine, (3) methamphetamine, (4) heroin, (5) hallucinogenic drugs, and (6) club drugs, also called *designer drugs,* such as Ecstasy, ketamine, GHB, and Rohypnol.

Marijuana is the common name for hemp, a tall plant that grows in most parts of the world. The main addictive chemical in marijuana is *tetrahydrocannabinol* (THC), which can be detected in urine. People usually smoke the dried leaves and flowers of the plant in cigarettes or pipes. Some may mix marijuana with food and beverages. A thick, sticky resin of the plant, called *hashish,* can be eaten or smoked.

Researchers have found that marijuana is addictive, producing dependence and a flulike withdrawal syndrome for some. Repeated, heavy use of marijuana impairs memory and learning and can significantly reduce motivation. Marijuana can cause distortions in perception, loss of coordination, increased heart rate, anxiety, and panic attacks. The medical consequences of smoking marijuana are similar to those caused by smoking cigarettes, including lung damage, chronic cough, and bronchitis. Marijuana is one of the most common addictions among teen-agers.

Cocaine is a powerful stimulant made from the leaves of the coca plant native to South America. Cocaine is often snorted through the nose. It can also be smoked in a form called *crack cocaine,* or injected intravenously. Smoking or injecting cocaine allows high concentrations of the drug to reach the brain, producing an intense immediate *euphoria* (feeling of well-being) known as a "rush" or "high." The drug is powerfully addictive in these forms. Injecting cocaine increases the risk for acquiring HIV, the virus that causes AIDS.

The physical effects of cocaine use include constricted blood vessels, dilated pupils, and increased body temperature, heart rate, and blood pressure. Some cocaine users report feeling restless, irritable, and anxious. Smoking crack cocaine is especially known to produce *paranoia,* a delusion of persecution that can lead to aggression. Cocaine-related deaths often result from sudden stoppage of the heart or lungs called *cardiac* or *respiratory arrest.*

When addicted individuals stop using cocaine, they often develop intense cravings for the drug and often experience depression during withdrawal from the drug. Thus, addicts have great difficulty stopping.

Methamphetamine is an addictive drug that strongly stimulates the central nervous system. Methamphetamine has some limited medical uses, primarily in the treatment of obesity and *attention deficit hyperactivity disorder* (ADHD). However, most methamphetamine used by drug abusers is made in illegal, makeshift laboratories. It is sold on the street under such names as "chalk," "speed," "meth," "crystal," "ice," and "crank."

Methamphetamine can be taken orally, snorted through the nose, smoked, or injected. The drug causes the release of the chemical *dopamine* in the brain. Dopamine is a *neurotransmitter* (chemical that carries signals from one nerve cell to another) that stimulates brain cells, enhancing mood and energy. Repeated methamphetamine use, however, damages the brain cells that produce dopamine and other neurotransmitters, such as *serotonin.* This damage may eventually reduce the brain's ability to produce the dopamine and can result in mood problems and movement disorders.

Smoking or injecting methamphetamine causes an intensely pleasurable sensation lasting only a few minutes. Users can become addicted to the drug quickly and use it more often at increasingly higher doses.

Methamphetamine increases alertness, physical activity, heart rate, and body temperature. It can also cause increased anxiety, irritability, confusion, *tremors* (shaking), seizures, insomnia, paranoia, and aggression. The drug can cause irreversible damage to blood vessels in the brain, causing stroke. Other effects include breathing problems, irregular heartbeat, *anorexia* (lack of appetite) with serious weight loss, heart attack, and death.

Heroin and a group of related drugs called *opiates* are made from the sap of the opium poppy. Opium, the dried sap of the poppy's seed pods, contains a potent chemical called *morphine.* Physicians use morphine to relieve severe pain. *Codeine* is a less potent opiate used to relieve coughs and mild pain. Cough syrups with codeine can be addictive if used over a long time.

Heroin is a highly addictive drug. Most heroin users inject the drug. After injecting heroin, the user feels a surge of euphoria accompanied by a warm flushing of the skin, a dry mouth, and heavy extremities. Following this initial euphoria, mental functioning becomes clouded due to the depression of the central nervous system.

Withdrawal from heroin can occur within hours after the last dose, causing drug craving, restlessness, muscle and bone pain, insomnia, diarrhea and vomiting, cold flashes, involuntary kicking movements, and other unpleasant symptoms. Addiction to heroin and other opiates is difficult to treat. Heroin addicts are often treated with safer, longer-acting opiates, such as *methadone,* to help them stop using the more dangerous injected drug. Heroin abuse can cause serious health conditions, including fatal overdose, collapsed veins, and infectious diseases, including AIDS and hepatitis.

Hallucinogenic drugs include naturally occurring drugs, such as mescaline, produced by the peyote cactus, as well as manufactured substances, such as *LSD* (lysergic acid diethylamide), made in laboratories. Hallucinogenic drugs affect the senses, emotions, and reasoning, often producing delusions or visions. *PCP* (phencyclidine) is a hallucinogenic drug once used as an anesthetic for animals. PCP may cause violent behavior and mental disturbance.

Heavy, repeated use of hallucinogens can cause long-lasting disturbances in perception. This condition, called

Some commonly abused drugs

Name	What they do	Some possible immediate health effects	Some possible long-term effects
Stimulants			
Amphetamines (Dexedrine, Benzedrine)	Speed up physical and mental processes, boost energy, create sense of excitement.	Appetite loss, blurred vision, dizziness, sweating, sleeplessness, trembling, anxiety, hallucinations.	Malnutrition, depression, memory impairment, mental illness, stroke, heart failure.
Cocaine and crack	Speed up physical and mental processes, create sense of heightened energy and confidence.	Rapid heartbeat, depression, sleeplessness, muscle spasms, convulsions, loss of sexual desire, impaired judgment, extreme suspiciousness, violence.	Damage to nasal lining, heart attack, stroke, hepatitis or AIDS (if injected). Risk of fatal overdose.
Depressants			
Barbiturates (Nembutal, Seconal)	Produce mild intoxication, drowsiness and lethargy. Decrease alertness.	Drowsiness, poor coordination, slurred speech, slowed breathing, weak and rapid heartbeat, impaired judgment, confusion, irritability.	Physical dependence, coma. Risk of fatal overdose. Sudden withdrawal can cause death.
Tranquilizers (Valium, Xanax)	Slow down the central nervous system and relax muscles. Decrease alertness.	Slurred speech, drowsiness, stupor. Impaired judgment.	Physical and psychological dependence.
Marijuana and hashish	Relax the mind and body, distort perceptions, alter mood.	Faster heartbeat and pulse, impaired perception and reactions, hallucinations, panic attacks, decreased motivation.	Impaired memory and coordination, bronchitis.
Heroin, morphine, codeine, and oxycodone	Relax central nervous system, relieve pain, produce sense of well-being.	Restlessness, nausea, vomiting, slowed breathing, lethargy, mood swings, sweating.	Physical dependence, malnutrition, lower immunity, infections of the heart lining and valves, liver disease, hepatitis or AIDS (from contaminated needles), and fatal overdoses.
Hallucinogenic drugs LSD, PCP, and mescaline	Alter perceptions and produce hallucinations, which may be frightening or pleasurable.	Increased heart rate, nausea, sweating and trembling on LSD. PCP can produce stupor and delusions of great strength and invulnerability. Mescaline can produce vomiting, fever, increased blood pressure and heart rate.	LSD may trigger disturbing flashbacks. PCP can cause coma, convulsions, heart and lung failure. Effects of mescaline unknown.
Club drugs			
Ecstasy	Speed up physical and mental processes, boost energy, create sense of excitement, may produce hallucinations.	Increased heart rate, distorted perception and sensation, confusion, depression, sleep problems.	Mood disorders, aggression, and learning problems.
Rohypnol	Relax the body and mind.	Slowed breathing, depression, loss of memory for events that occur under the influence of the drug.	Physical and psychological dependence. Withdrawal may cause seizures.
GHB	Relax the body and mind, create a sense of pleasure and well-being.	Slowed breathing, depression, loss of memory for events that occur under the influence of the drug.	Withdrawal may cause anxiety, sleeplessness, shaking, and sweating. Risk of fatal overdose.

post-hallucinogenic perceptual disorder, can last for months after discontinuing use of the drug.

Club drugs are created in laboratories. They are known as *club drugs* because people often use them at nightclubs, at dance parties called *raves*, and at other social gatherings. Common club drugs include *Ecstasy, GHB, Rohypnol,* and *ketamine.*

Ecstasy, also known as MDMA from its chemical name *3-4 methylenedioxymethamphetamine,* is a mind-altering drug with hallucinogenic and stimulant properties. Ecstasy can cause confusion, depression, sleep problems, anxiety, and paranoia. These symptoms sometimes persist weeks after taking the drug. Physical symptoms include muscle tension, nausea, blurred vision, faintness, chills or sweating, and increased heart rate and blood pressure. Researchers have found that Ecstasy may cause brain damage by destroying brain cells that regulate aggression, mood, sexual activity, sleep, and sensitivity to pain.

Rohypnol, the common name for the drug flunitrazepam, is a *sedative* (soothing) and *hypnotic* (sleep-inducing) drug that can produce deep relaxation and *amnesia* (loss of memory). The drug is taken orally in tablet form or dissolved in beverages. It is odorless and tasteless, and so it can be given to a person without his or her knowledge. Mixed with alcohol, it can incapacitate a victim and prevent him or her from resisting physical or sexual assault. It can also prevent the victim from remembering what happened while under the influence of the drug. Rohypnol can produce physical and psychological dependence or addiction.

GHB is the common name for gamma hydroxybutyrate, a clear, odorless powder or liquid drug. It is often abused for its euphoric, sedative, and *anabolic* (muscle-building) effects. The purity and strength of individual doses can vary greatly, increasing the chance of overdose. GHB overdose can lead to loss of consciousness, seizures, coma, and death. GHB withdrawal may produce insomnia, anxiety, tremors, and sweating.

Ketamine is an *anesthetic* (drug that produces a loss of feeling) normally used by veterinarians. It causes a dreamlike hallucinatory effect in people. It is sometimes added as a liquid to marijuana or tobacco products, or used as a powder and snorted. Ketamine at high doses can cause memory loss, delirium, loss of coordination, and sometimes deadly breathing problems.

Causes and effects of drug abuse

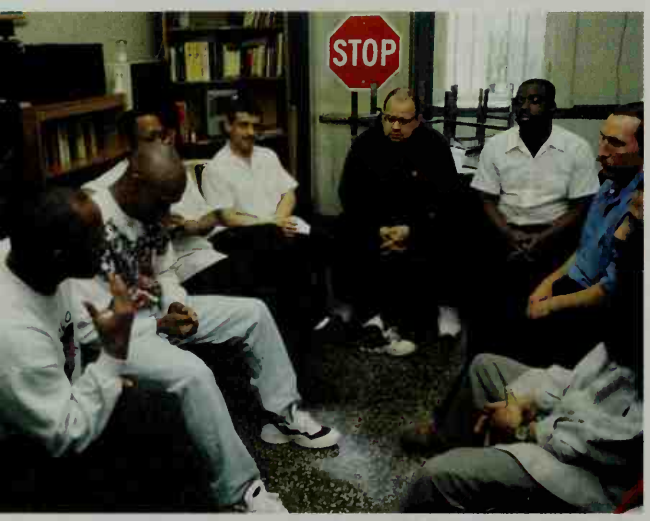
Most adults with drug dependence start abusing substances as teen-agers. Researchers have identified risk factors that increase children's chances of developing a substance use disorder. If many family members and relatives abuse drugs or alcohol, this may indicate that genetic factors play a role in increasing their risk of developing drug abuse. Toddlers and young children who are highly aggressive and have other behavior problems may also be at higher risk to develop a substance use disorder.

Many people continue to use drugs even if they want to stop because they have become drug dependent. Some addicts spend so much time and money trying to obtain drugs or under the influence of drugs that they neglect their family, friends, and work. Pregnant women who take drugs can cause harm to their unborn children. All drug users risk injury or death to themselves and others if they drive under the influence of a drug.

Drug users may resort to theft, prostitution, selling drugs, or other criminal activity to pay for their habits. Injecting drugs contributes to the spread of infectious diseases, such as hepatitis and AIDS. Health professionals using drugs may make mistakes that endanger their patients. Drug users in the transportation industry, such as bus drivers and air traffic controllers, risk endangering the public. Almost all workers using drugs perform less efficiently and make more mistakes.

Public concern about the drug problem has led to a demand for greater law enforcement efforts. The police have responded by making more arrests for drug possession and sales. As a result, drug offenders have crowded courtrooms, jails, and prisons, creating a burden on the criminal justice system.

According to the U.S. National Institute on Drug Abuse (NIDA), the rate of drug abuse is higher in the United States than in any other industrialized nation. The federal government estimates that Americans spend several billion dollars on illegal drugs each year. However, the actual cost of drug and alcohol abuse to society is much higher. NIDA and the National Institute on Alcohol Abuse and Alcoholism estimate the total economic cost of alcohol and drug abuse to be several hundred billion dollars each year. These costs include the price of hospitalization, property damage, time lost from work, and law enforcement efforts.



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Help for substance abusers may include counseling and group therapy, *shown here,* where they share experiences and support one another in efforts to remain drug- and alcohol-free.

Treatment of substance use disorders

The treatment of addiction is often difficult because drug use disrupts many parts of a person's life. Effective treatment must address all of these areas by helping the individual to stop using drugs and by teaching the skills the person needs to maintain a drug-free lifestyle. Treatment also helps the addicted individual and family members achieve a healthier life by changing patterns of behavior that trigger drug use.

Effective treatment of substance abuse or dependence includes both medications and therapy. Medications that are sometimes used to treat drug abuse can help decrease craving for drugs, such as the *nicotine patch* used to quit smoking. Other medications substitute a safer or less addictive medication for a more dangerous "street" drug. Some medications prevent the use of drugs by causing unpleasant physical reactions if drugs are taken. *Disulfiram,* a medication marketed under the name Antabuse, is given for alcohol abuse. It causes dizziness and vomiting in people who ingest alcohol. Physicians may also prescribe medications to treat common co-occurring disorders, such as depression, that drug abusers often experience along with their addiction.

Some people require *detoxification treatment* with medically supervised withdrawal from drugs before other treatment can begin. Detoxification is used to end a person's physical dependence on a drug by eliminating the drug from the body. Some programs involve decreasing drug doses gradually over a period of weeks.

Detoxification should be accompanied by and followed by other treatment, including counseling to help addicted individuals fight cravings and solve the problems that first led them to drugs. Behavioral therapy and family therapy focus on helping people with addictions by teaching them to change unhealthy habits, behavior, thinking, and family patterns. Many people with addictions are helped by such groups as Alcoholics Anonymous (AA) or Narcotics Anonymous (NA), where others with the same addictions come together to share their experiences and support each other in remaining drug and alcohol free.

People with addictions often *relapse* (begin taking drugs again). Relapsing after treatment does not mean that drug treatment is ineffective. Researchers have found that drug addiction is a chronic, relapsing medical and psychiatric illness similar to other chronic illnesses, such as diabetes or depression. Longer-term, scientifically based treatments for addiction can be as effective as treatments for many other chronic illnesses.

Combating drug abuse

Reducing supply. The United States has one of the world's largest, most profitable illegal drug markets. Such profits attract drug suppliers from many parts of

AP/Wide World

Police seize illegal drugs destined for sale in the United States. Each year, law enforcement agencies throughout the world spend millions of dollars to combat illegal drug trafficking.

the world. To discourage drug smuggling and dealing, known as *drug trafficking,* the United States has severe punishment for anyone convicted of those crimes. Drug traffickers can receive a minimum sentence of 5 to 10 years in prison. Drug traffickers can receive the death sentence if a death results from their drug activity. The Drug Enforcement Administration (DEA), a part of the U.S. Department of Justice, combats drug trafficking within the United States and abroad. It works with federal agencies and other governments to arrest those who produce, process, distribute, and finance illegal drugs.

Reducing demand. Schools and communities play an important role in preventing drug use. Prevention programs work to reduce the risk of young people starting to use drugs as teen-agers. Effective prevention programs educate students about the dangers of drugs from an early age. These programs also try to impress on young people the advantages and value of a healthy life. Effective prevention programs also help families discuss the dangers of drug use openly and honestly.

Communities help prevent drug use by strictly enforcing laws that prevent the sale of tobacco, alcohol, and other drugs to children and adolescents. Prevention and early treatment efforts focus on solving the behavioral, family, and school problems of these children. These efforts may prevent the children from turning to drug use.

The United States has several laws to discourage and reduce the risk of drug abuse. The Comprehensive Drug Abuse Prevention and Control Act of 1970 lists the most habit-forming and dangerous drugs. It also strictly regulates the manufacture, sale, possession, and use of frequently abused drugs.

The Anti-Drug Abuse acts of 1986 and 1988 set high penalties for drug trafficking and possession. They also approved funding for drug abuse treatment and research programs, and for antidrug law enforcement efforts.

To discourage drug use among employees, some companies test workers for the presence of drugs in their urine, blood, or hair. Many employers require job applicants to pass a drug test. Other companies have random testing for airline pilots, railroad operators, and others involved in public safety. The United States began testing military personnel for drug use in 1981.

The legalization debate. The problem of drug abuse persists in the United States despite billions of dollars spent each year trying to eliminate it. Because efforts to reduce drug abuse and drug-related crime have not been as effective as hoped, some people have suggested that drugs be legalized.

Supporters of legalization believe laws against making and selling drugs should be overturned. They argue that if drugs were legally available at low prices, illegal drug dealers would go out of business and drug-related crime would be reduced. The billions of dollars spent on law enforcement could then be devoted to drug education and treatment programs.

Others suggest changing the law so that possession of drugs in small amounts would not be a criminal offense. Such changes, called *decriminalization,* would make personal use of drugs legal or subject only to a small fine. Efforts to arrest drug traffickers, however, would continue.

Legalization opponents fear that making drugs low-priced and easily available would encourage the use of dangerous substances. They argue that, when substances have been legalized and become more available, such as alcohol and tobacco, they have become much more widely used and abused. Such abuse has caused major public health problems and costs to society. Legalized drugs would be available to everyone, including those most at risk to develop addictions. The number of people who will develop problems associated with drug abuse and addiction would also increase.

History

Drugs have been used for thousands of years in their natural plant form. In the 1800's, scientists learned how to separate drugs chemically from plants. Such advances in chemistry made morphine, cocaine, and heroin available for the first time. Initially, doctors welcomed these powerful drugs as helpful, safe pain-relievers. Gradually, people realized how easily these drugs could become dangerously habit-forming.

In the late 1800's, most countries had no national laws controlling drugs. People could buy opium and morphine whenever they wanted. Many medicine companies hid the fact that their remedies contained habit-forming substances. As a result, many people developed a drug dependency. By the early 1900's, many countries faced an epidemic of drug abuse.

In the United States, the first federal law to help protect the safety of people using drugs was the Food and Drugs Act of 1906. This act required labeling of the amount of certain substances, including opiates, cocaine, and marijuana, in nonprescription drugs. However, people could still purchase dangerous drugs legally.

Public pressure for national controls over narcotic and cocaine sales led to the Harrison Act of 1914. The act required the payment of a small tax every time a drug changed hands, from the manufacturer down to

the doctor or pharmacist. The government used the taxes to control availability and sale of the drugs. The act also required registration of all physicians and pharmacists and made opiates and cocaine available only by prescription. In 1919, the act was expanded to prevent physicians from freely prescribing habit-forming opiates. Doctors could only renew prescriptions for opiates for serious medical reasons, such as severe pain.

In 1937, Congress passed the Marijuana Tax Act, banning the nonmedical or untaxed possession of marijuana. By the early 1940's, use of this drug was minimal.

In the 1950's, use of amphetamines, tranquilizers, and marijuana increased. In the 1960's and the 1970's, drug use soared. Marijuana, LSD, and other drugs gained broad social acceptance. Many young people used drugs in a search for spiritual insight, as a rejection of adult values, a way to cope with their problems, or simply for pleasure. In the 1980's, people grew familiar with the destructive side of drugs and began once again increasing efforts to solve the problems of drug abuse.

Scientific research on drug abuse, addiction, and the effects of drugs and alcohol has increased dramatically. NIDA funds most of the world's research on the causes, biological effects, prevention, and treatment of addictions. The NIDA Web site at www.drugabuse.gov provides accurate information on a wide range of topics.

Paula DeGraffenreid Riggs

Related articles in *World Book* include:

Adolescent (Alcohol and drug abuse)
AIDS (How the virus is transmitted)
Alcoholic beverage
Alcoholism
Amphetamine
Barbiturate
Blood doping
Cocaine
Codeine
Depressant
Disulfiram
Drug Enforcement Administration
Drug testing
Ecstasy
Hallucinogenic drug
Hashish
Heroin
Inhalant
LSD
Marijuana
Mental illness (Substance use disorders)
Mescaline
Methadone
Methamphetamine
Morphine
Narcotic
Opium
Smoking
Steroid
Stimulant
Tobacco

Outline

I. **Abuse of legal drugs**
   A. Alcoholic beverages
   B. Tobacco
   C. Inhalants
   D. Over-the-counter drugs
   E. Prescription drugs
   F. Steroids
II. **Abuse of illegal drugs**
   A. Marijuana
   B. Cocaine
   C. Methamphetamine
   D. Heroin
   E. Hallucinogenic drugs
   F. Club drugs
III. **Causes and effects of drug abuse**
IV. **Treatment of substance use disorders**
V. **Combating drug abuse**
   A. Reducing supply
   B. Reducing demand
   C. The legalization debate
VI. **History**

Questions

Why do people begin using drugs?
What are the costs of drug abuse to society?
Why do some people believe that drugs should be legalized?
What are club drugs?
How may drug use lead to criminal activity?
What is the chief U.S. government agency that combats illegal drugs?
Why did many people in the 1800's develop drug dependency?
In what occupations are many workers tested for drug use?
What are inhalants?
What are the difficulties in treating drug addiction?

Additional resources

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Drug addiction. See Drug abuse.

Drug Enforcement Administration (DEA), an agency of the United States government, enforces federal laws and regulations dealing with narcotics and other dangerous drugs. The DEA investigates illegal drug traffic and arrests suspected offenders. It also works to help reduce demand for illegal drugs and regulates production and distribution of certain drugs.

The DEA investigates the smuggling of narcotics and dangerous drugs into the United States and the distribution of such drugs. It arrests suspected distributors, financiers, importers, and processors of illegal drugs. The agency works with local, state, and federal law enforcement organizations and with agencies of other nations to combat illegal drug traffic and abuse.

The DEA was established in 1973 as part of the U.S. Department of Justice. The agency's functions had previously been performed by three Justice Department offices and the Bureau of Customs (now the U.S. Customs Service). The DEA has headquarters in Arlington, Virginia.

Critically reviewed by the Drug Enforcement Administration

Drug testing is the analysis of body fluids to determine whether a person is using illegal drugs. Such tests are widely used in the workplace, in the military, and in criminal justice and drug treatment programs. Some athletic associations and schools also use drug tests.

Modern drug testing employs accurate and reliable biochemistry techniques. Generally, the procedure involves sending a urine sample to a laboratory for an initial screening test called an *immunoassay.* If the result of that test is positive, a confirmation test, called *gas chromatography/mass spectrometry,* is used to confirm the results. The laboratory will not report a positive test result unless both tests show the presence of an illegal drug. In addition, positive test results are typically reviewed by a physician to determine whether the individual has a legal reason for using the drug.

Since the 1980's, drug testing of employees and job applicants has become standard in many industries. Numerous business leaders believe that people who use illegal drugs will be poor workers and may endanger the lives of their co-workers. But some workers view drug testing as a violation of their privacy and civil rights. Some people have concerns about the tests' accuracy.

In 1986, the United States government ordered all federal agencies to screen their employees for illegal drug use. Since that time, the government has issued regulations that require drug testing in the nuclear power in-

dustry and in transportation companies, including airlines and railroads. Many state and local agencies also have adopted drug-testing programs.

Physicians sometimes perform drug tests to find out whether a patient is taking the correct amount of a prescribed medication. In addition, the term *drug testing* may be used to refer to tests carried out by drug manufacturers to determine the effectiveness of drugs they wish to make and sell legally. J. Michael Walsh

Drug therapy. See Chemotherapy; Mental illness (Drug therapy).

Drugstore. See Drug; Pharmacy.

Druids, *DROO ihdz,* were the priestly, learned class among the Celts, a people of ancient Europe. The Druids were judges and lawmakers as well as priests. They led religious ceremonies, settled legal disputes, and served as leaders and advisers to their people.

Druidism, the religion of the Druids, involved the worship of many gods. The Druids regarded mistletoe and oak as sacred. They believed the soul was immortal and entered a new body after death. The Druids killed animals and possibly people as sacrifices. They studied the flights of birds and the remains of sacrificed animals to foretell the future. The Romans, who conquered much of Europe between about 300 B.C. and A.D. 100, tried to stop Druidism. The religion died out after the Celts became Christians in the 400's and 500's.

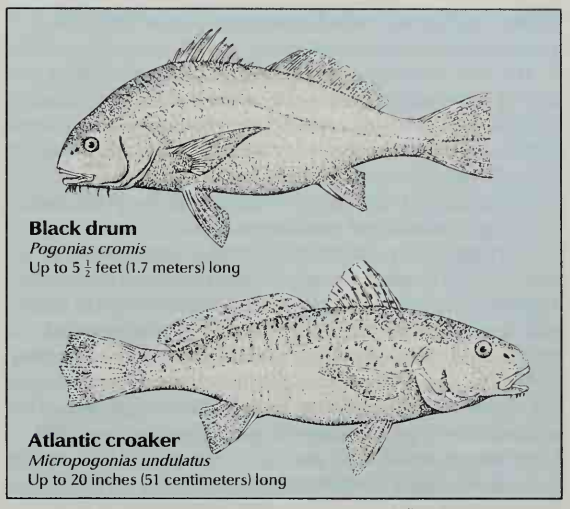
During the 1600's, the descendants of the Celts became interested in their Druidic heritage. Today, several groups in the United Kingdom and Ireland practice what they believe to be ancient Druidism. They hold Druidic festivals at the beginning of spring, summer, autumn, and winter. A major celebration takes place at Stonehenge, a monument near Salisbury, England, that the Druids are said to have used. In Wales, festivals of music and poetry called *eisteddfods* (pronounced *ay STEHTH vahdz*) include Druidic rites. Christopher McIntosh

See also Halloween (Samhain).

Drum is any member of about 200 species of fishes. Some drums are also called *croakers.* Drums get their name from the sound some of them make. These drums repeatedly tighten certain muscles on their swim bladder in the abdomen. When the muscles tighten, they produce vibrations that sound like drumming. Many kinds of drums live in warm, shallow ocean water near the shores of most continents. Some spend part of their early life in freshwater rivers or in bays where fresh and salt water are mixed. But only one species, the *freshwater drum,* spends its entire life in fresh water. The freshwater drum lives in large lakes and rivers from Canada to Central America.

Drums range in size from species that weigh about 1 pound (0.45 kilogram) to those that weigh more than 100 pounds (45 kilograms). The *totuava,* which lives in the Gulf of California, is the heaviest. This rare fish weighs as much as 225 pounds (101 kilograms) and measures up to 6 feet (1.8 meters) long. Most drums have a scaly head; a blunt, rounded nose; and two upper fins separated by a notch.

Many drums, including the *red drum* and the *white croaker,* have teeth only in the rear of their mouth. These flat, grinding teeth enable the drums to eat clams, crabs, shrimp, and other shellfish that they find along the ocean floor. Other drums, including the *spotted seatrout* and the *weakfish,* have sharp front teeth that allow them to feed on such free-swimming animals as shrimp, squid, and small fish (see **Weakfish**).



WORLD BOOK illustrations by Marion Pahl

Several kinds of drums are popular seafood. Commercial fishing crews catch black drum and Atlantic croakers off the Atlantic Coast of North America. These fish have firm, white flesh.

Commercial fishing crews use nets to catch several kinds of drums, including the *Atlantic croaker,* the *black drum,* and the red drum. The drum's firm, white flesh makes it a popular seafood.

Two drums of the tropical Atlantic, the *jackknife-fish* and the *high-hat,* are favorites of aquarium owners. These small fish have an extremely high fin on their back, and interesting black-and-white markings.

William N. Eschmeyer

Scientific classification. Drums make up the drum family, Sciaenidae.

Drum is the oldest musical instrument. It is a member of the percussion family, which consists of instruments that are played by striking them with the hand, sticks, or other objects. Drums have also been used for nonmusical purposes. For example, people of many cultures have used drums to communicate over long distances.

The *shell* (body) of a drum may be shaped like an open cylinder or a kettle. A thin covering called a *drumhead* is stretched tightly across the opening. Drumheads may be made of either calfskin or plastic. A cylinder-shaped drum generally has two drumheads. A kettle-shaped instrument has one. A musician strikes the drumhead with sticks, with mallets, or with the hand to create vibrations that produce a sound. This sound *resonates* (increases) inside the shell of the drum.

The three most popular types of drums are the *snare drum,* the *bass drum,* and the *timpani.* Only the timpani can produce definite musical notes. The other types are used primarily as rhythm instruments.

The snare drum consists of a metal or wooden cylinder with a drumhead covering each opening. The drumhead used for playing is called the *batter head.* The opposite one is called the *snare head.* About 12 gut or wire strings called snares stretch across the snare head. A drummer strikes the batter head with two wooden

sticks. The snares vibrate against the snare head, producing a full, crisp sound.

The bass drum resembles a large snare drum. The drumhead used for playing is called the *beating head,* and the opposite one is called the *resonating head.* At times, the drummer may play both heads at the same time. The drummer uses mallets to create a deep, booming sound. Various tone colors can be produced by using felt, wool, or wooden mallets.

The timpani are played in pairs or in groups of four. The drum is shaped like a kettle and is often called a *kettledrum.* It consists of a large copper or fiberglass shell with a single drumhead. A pedal mechanism enables the player to tune the drum to different pitches. Timpani produce a deep, resounding tone achieved by striking the drumhead with mallets. Different tone colors may be obtained by using a variety of mallets made of soft felt, hard felt, or wood. John H. Beck

Related articles in *World Book* include:

Bongo drums
Conga drum
Drum and bugle corps
Jazz (The drums)
Tambourine
Tom-tom

Drum and bugle corps, often called *drum corps,* are marching musical groups that perform in parades, at football games, and in competitions. Unlike marching bands, drum corps do not use woodwind instruments. They also have larger percussion sections. In addition, members pay to participate in drum corps, whereas most marching bands are school sponsored.

Drum corps play difficult arrangements of classical, jazz, and rock music, as well as original compositions, while marching in complex drills. The drills include rifle and flag twirling and dancing. Drum corps may contain up to 60 bugle players, 30 percussionists, over 30 people in the *auxiliary* or *color guard,* and 1 or 2 drum majors. At competitions, judges rate drum corps on brass, percussion, and visual and general effect.

There are two levels of drum corps. Junior corps consist of members who are younger than 21. Senior corps have no age limit.

The first drum and bugle corps in the United States were sponsored by the Veterans of Foreign Wars and the American Legion just after World War I (1914-1918). Until the 1940's, corps were small and used bugles with no valves. Over the years, valves and different-sized bugles were added so that more pitches could be played. In 1972, the various drum and bugle corps in the United States merged in order to form Drum Corps International. Stewart L. Ross

Drumfish. See Drum.

Drummond, William Henry (1854-1907), was a Canadian poet and physician. He was called the *poet of the habitants.* French-Canadian farmers once called themselves *habitants.* Drummond was interested in their way of life, and that of the *voyageurs* (trappers and boaters). Drummond turned their simple folk tales and legends into poems. He learned stories from farmers and backwoods people after he became a country doctor at the age of 30. His books of poetry include *The Habitant* (1897) and *The Voyageur* (1905). Drummond was born in County Leitrim, Ireland. He moved to Canada with his parents when he was 10 years old. Rosemary Sullivan

Drupe, *droop,* is a fleshy fruit that has a single seed surrounded by a hard covering called a *stone* or *pit.* The pulp is usually covered with a thin skin. Drupes include the olive, plum, apricot, cherry, and peach. See also **Fruit** (Simple fruits; illustration: Drupes). James E. Pollard

Druses, *DROOZ ehz,* are an Arabic-speaking people of the Middle East. There are more than 500,000 Druses, who are also known as the *Druze* or *Druzes.* About half of them live in the Hauran districts of Syria. Most of the rest live in Lebanon and about 40,000 Druses reside in Israel. Some Druses have immigrated to the United States and Canada.

The Druses practice a secret religion related to Islam. Al-Hakim, a ruler of Egypt during the A.D. 1000's, founded the religion. He declared that he was God. When he died, Ismail al-Darazi, one of his followers, spread the religion to the people in the Syrian mountains. The name *Druse* probably comes from *Darazi.*

The Druses in Lebanon had little political representation before the 1990's. They played a key role in fighting that broke out against the Lebanese government during the early 1980's. The Druses ended their fighting against the government in late 1990. In 1990 and 1991, they gained representation in Lebanon's government in accordance with a 1989 peace agreement.

Vernon Robert Dorjahn

Dry cleaning is a process that removes dirt and stains from fabrics without washing them in water. Dry cleaning uses little or no water, but in no case is the process dry. Rather, it involves the use of liquid *solvents* (substances that dissolve other substances).

Dry-cleaning plants clean items that may shrink, fade, or be damaged in some other way if washed in water. These items include certain clothing, such as garments made of wool or silk, and household objects such as draperies and bedspreads.

Some materials should not be dry cleaned. For example, dry cleaning may cause vinyl or artificial leather to crack or split. Most garments have *care labels* that tell how to clean them.

How clothes are dry cleaned. Workers begin the process by sorting the clothes according to color and type of fabric. Workers in a stain-removal department then *pretreat* garments by brushing or spraying stains and spots with special chemicals. These chemicals loosen or remove spots that might otherwise become permanent later in the process.

Other workers then put the clothes into a large machine that resembles a washing machine used in the home. The dry-cleaning machine has a rotating drum that is filled with a liquid solvent instead of water. Most machines use a synthetic solvent. Others use liquid carbon dioxide as the solvent. Workers usually add a dry-cleaning detergent to the solvent to help remove water-soluble spots. As the drum rotates, the solvent circulates through the garments.

After the cleaning cycle, the solvent drains from the machine. The drum spins rapidly to remove most of the solvent from the clothes. Unlike water used in home washers, the solvent in the dry-cleaning machine is filtered and reused. Workers then tumble dry the clothes, usually in the same machine.

Next, the garments return to the stain-removal department. There, a *stain-removal technician* examines whatever stains remain. He or she determines which stains can be removed without damage to the fabric or the

dye. The stain-removal technician then wets these stains with a steam gun, a nozzle that sprays a jet of water vapor. Finally, the technician treats the spots with chemicals.

From the stain-removal department, the garments go to a presser or finisher. This worker uses presses, hand irons, and steaming equipment to remove wrinkles and restore the shape and texture of the garments.

The dry-cleaning industry is an important service industry in many countries. Many large hotels and department stores offer dry-cleaning services to their customers. Critically reviewed by the International Fabricare Institute

Dry dock is a dock in which a vessel can lie out of the water while repairs are being made below its water line. The two chief kinds of dry docks are graving docks and floating docks.

Graving docks are used chiefly to repair large ships in shipyards. *Graving* was a term used in the days of wooden ships to mean cleaning a vessel's bottom and coating it with tar. A graving dock looks like a huge, concrete bathtub sunk into the ground. One end of the dock opens onto a harbor, river, or other waterway.

When a ship enters a graving dock, shipyard workers place a huge floating or sliding *caisson,* or gate, against the open end. Pumps suck the water out and the vessel slowly sinks. Its *keel,* or bottom, comes to rest on wooden blocks placed on the floor of the dock. *Spars,* or long pieces of wood wedged between the ship and the sides of the dock, also help support the vessel. When repairs are completed, workers flood the dock until the water reaches the same level as the water outside the gate. It is opened and the ship leaves.

Floating docks can be self-propelled or towed from place to place. They are important in war to repair ships in forward battle areas. A floating dock looks like a shoebox with the top and ends removed. Some types are built in U-shaped sections that can be assembled to make one large dock.

The *hull,* or bottom, and *wingwalls,* or sides, of a floating dock contain compartments. Water enters these compartments, making the dock sink low enough to allow a ship to enter. Pumps then suck the water out and the dock rises, lifting the ship out of the water. Wooden blocks and spars help support the vessel. When repairs are completed, the compartments are flooded again until the dock sinks enough to allow the ship to float. Such docks can raise an average-sized ship in from one to two hours. John F. Wing

Dry farming is a process of growing crops in semiarid regions without irrigation. Semiarid regions often receive little rainfall during the crop-growing season. Therefore, farmers in these regions try to increase the amount of water that soaks into the soil during rainy or snowy periods. During the growing season, the roots of crops absorb water stored in the soil.

Dry farming includes various practices that help increase the amount of moisture in the soil. A large number of farmers leave part of their cropland *fallow* (unplanted) each year. The fallow soil stores moisture for the following year's crop. Instead of plowing the land, the farmer tills the soil 3 to 4 inches (8 to 10 centimeters) deep. This technique, called *shallow cultivation,* kills weeds, which absorb moisture from the soil.

Many farmers use *stubble-mulch tillage.* In this practice, large sweeps of a plow undercut the surface and kill weeds, leaving dead stalks and other plant wastes on the surface. These crop residues protect the soil from wind erosion, reduce the rate of evaporation of water from the soil, and increase the rate at which the soil absorbs water. Residues on the surface also trap blowing snow, which eventually melts and enters the soil. Some farmers control weeds with chemical herbicides rather than tillage. This technique, called *no-till, no-tillage,* or *zero tillage,* retains all crop residues on the surface.

Another dry-farming technique is *contour tillage,* which is practiced on sloping land. In contour tillage, the farmer plows across a slope, rather than up and down. The tilled soil forms small furrows. These furrows prevent rainwater from running down the slope. Thus, the water stays on the slope and soaks into the ground.

Only certain hardy crops, such as barley, cotton, sorghum, and wheat, can be grown by dry-farming methods. Even so, many farmers plant these crops as early as possible in the growing season so that the plants mature before the weather becomes too hot and dry.

Dry farming is practiced in semiarid regions of many countries, including Australia, Canada, China, Kazakhstan, Russia, and the United States. The largest U.S. dry-farming region lies in the Great Plains. Researchers have improved many dry-farming techniques and have developed new crop varieties that need little water. These improvements have increased food and fiber production in dry-farming regions. Ordie R. Jones

Dry ice is solid carbon dioxide. The name *dry ice* refers to the fact that the substance changes from a solid to a gas without first becoming liquid. Because of this property, dry ice is widely used in industry to refrigerate food, medicine, and other materials that would be damaged by the melting of ordinary ice. Chemists use a mixture of dry ice and acetone or isopropyl alcohol to cool chemicals during certain reactions.

Dry ice is made in snowlike flakes or in blocks. Flakes are produced by cooling and compressing liquid or gaseous carbon dioxide. Blocks are formed by further compression of the flakes.

The chemical formula for dry ice is CO_2. Dry ice has a temperature of −109.3 °F (−78.5 °C), which is much colder than the temperature of ordinary ice. For this reason, special care must be taken when handling dry ice to avoid frostbite. Robert J. Ouellette

See also **Food, Frozen** (Dry-ice freezing); **Rainmaking** (Rainmaking methods).

Dry Tortugas, *tawr TOO guhz,* **National Park** is made up of 27 low coral islands, or *keys,* which lie about 70 miles (115 kilometers) west of Key West, Florida. The park is a coral reef system that supports unusual bird and marine life. Spanish explorer Ponce de León reached the islands in 1513. He named them Tortugas—which means turtles in Spanish—for the many turtles he found there. The later name, Dry Tortugas, refers to the fact that the islands contain no fresh water. Historic Fort Jefferson is located in the park. The fort was constructed between 1846 and 1866 to protect the United States from invasion. Fort Jefferson became a national monument in 1935. In 1992, the area was designated Dry Tortugas National Park. For the area of the park, see **National Park System** (table: National parks).

Critically reviewed by the National Park Service

Dryden, John (1631-1700), was the outstanding English writer of the *Restoration period* (about 1660 to 1700). He excelled as a poet, dramatist, and literary critic. Dryden believed that the individual is part of a society that has its roots in ancient Greece and Rome. He also believed that literature and the arts have value as civilizing forces. As a result, his writings deal with large social, political, and humanistic issues.

Dryden was born in Northamptonshire, and studied at Trinity College, Cambridge. He began writing after moving to London in the late 1650's. Dryden wrote only poetry at first, but he later began writing plays to make a living. His finest play is *All for Love* (1677), an adaptation of William Shakespeare's *Antony and Cleopatra.* Dryden simplified Shakespeare's story and concentrated on the tragic passions of the two famous lovers. He also wrote the heroic drama *The Conquest of Granada* (1670, 1671) and the sophisticated comedy *Marriage à la Mode* (1672).

Dryden's best poems sprang from his involvement with political controversies. In 1668, he was appointed poet laureate and in 1670 became the royal historiographer. He became involved in political disputes between King Charles II and Parliament. A Tory, he joined the king against the Whigs. Dryden's poem *Absalom and Achitophel* (1681) is a brilliant political satire based on Absalom's rebellion against King David, which is described in the Old Testament. *The Medal* (1682) is an even more biting attack on the Whigs. His most famous poem, *MacFlecknoe* (1682), is a satire written in mock-epic style against a literary foe, Thomas Shadwell.

Dryden also wrote to defend his religious faith. *Religio Laici* (1682) is a poem that defends the Church of England against its enemies. Dryden became a Roman Catholic about 1686 and wrote *The Hind and the Panther* (1687) in defense of Catholicism.

In 1688, King James II, a Catholic, lost his throne. William and Mary, who were Protestants, became king and queen in 1689. Dryden refused to swear allegiance to the new rulers, and he lost his government positions. He wrote a few plays and poems after 1688 but spent much of his time translating works to support himself. Dryden's most famous translations are the poems of Virgil (1697). "Alexander's Feast" (1697) is his best poem of the period.

Dryden also wrote much literary criticism. His best works include *An Essay of Dramatic Poesy* (1668), which expresses his admiration for Shakespeare; and his preface to a collection of fables published in 1700, in which he praised Chaucer. Gary A. Stringer

See also **English literature** (John Dryden).

Additional resources

Haley, David. *Dryden and the Problem of Freedom.* Yale, 1997.
Winn, James A. *John Dryden and His World.* Yale, 1987.

DT's. See **Delirium tremens.**

Du Barry, Madame (1746-1793), was a mistress of King Louis XV of France. She was the last important member of a series of mistresses who played significant roles in Louis's court. See **Louis XV.**

Du Barry was born Marie-Jeanne Bécu in Champagne, France. Her parents were poor, and she had little education. She first worked in a hat shop in Paris but soon became the mistress of Count Jean du Barry and other noblemen. She met Louis while living with Jean du Barry. Custom at the royal court required that Bécu gain higher social rank before she could become Louis's official mistress. Therefore, she married Jean's brother, Guillaume du Barry, thus acquiring the title countess. Madame du Barry became Louis's official mistress in 1769. At court, she was frequently involved in plots and schemes. Jealous rivals and the king's ministers hated her.

Detail of portrait by Madame Vigée-Lebrun, private collection. Bulloz from Art Reference Bureau

Madame du Barry

After Louis's death in 1774, Madame du Barry was sent to a convent for a time. During the French Revolution (1789-1799), she was accused of aiding various people who sought to restore the French monarchy. She was executed on the guillotine. Maarten Ultee

Du Bellay, *doo buh LAY,* **Joachim,** *zhaw a KEEM,* (1522-1560), was a French poet. With his friend Pierre de Ronsard, he founded a group of poets called the Pléiade. Du Bellay's essay *Defense and Glorification of the French Language* (1549) established the literary doctrines of the group.

Du Bellay was born in Anjou of a noble, but poor, family. He lived in Rome from 1553 to 1557, and he wrote the major parts of two brilliant volumes of verse, *Antiquities of Rome* and *Regrets* (both 1558), while there. In *Antiquities,* he praises the virtues and continuing influence of ancient Rome. In *Regrets,* written during a self-imposed exile from France, he satirizes the corruption of modern Rome and speaks with both bitter disillusionment and longing of his native country.

Robert B. Griffin

See also **French literature** (The Pléiade).

Dubinsky, *doo BIHN skee,* **David** (1892-1982), an American labor leader, was president of the International Ladies' Garment Workers' Union from 1932 to 1966. He also helped found the Committee for Industrial Organization in 1935, which later became the Congress of Industrial Organizations (CIO). He became a founding vice president of the American Federation of Labor Congress of Industrial Organizations (AFL-CIO) in 1955. He became noted for work in collective bargaining, labor's international affairs, and antiracketeering. Born in Brest-Litovsk, Russia (now Brest, Belarus), Dubinsky was arrested for union activity there and was exiled to Siberia. He escaped and moved to the United States in 1911.

Jack Barbash

Dublin, *DUHB lihn* (pop. 502,749; met. area pop. 866,241), is the capital and largest city of the Republic of Ireland. It lies on Ireland's east coast at the mouth of the River Liffey (see **Ireland** [political map]). Dublin is Ireland's economic, political, and cultural center. About a fourth of Ireland's people live in the Dublin area.

The city occupies a beautiful site, with Dublin Bay to the east and the Dublin Mountains to the south. Rolling plains extend west and north of Dublin. The River Liffey flows through the city.

Dublin has many wide streets and spacious squares lined with lovely houses and public buildings. Many of these buildings date from the 1700's. Large apartment and office buildings were built during the 1900's.

Dublin's main shopping section lies along and near O'Connell and Grafton streets, which run north and south near the center of the city. O'Connell Street measures about 150 feet (46 meters) wide and is one of the widest streets in Europe. Statues of some famous Irish people stand down the center of this street.

A busy port and a manufacturing area are at the mouth of the River Liffey. Many office buildings and other important structures rise south of the river. This area includes Dublin Castle, St. Patrick's and Christ Church cathedrals, and the University of Dublin—also called Trinity College. Also in the area are the National Art Gallery, the National Library, the National Museum, and Leinster House—the meeting place of Ireland's parliament. Attractions north of the river include the Abbey Theatre and two historic buildings called Custom House and the Four Courts. Phoenix Park, which lies to the northwest, is one of the largest city parks in the world.

Economy. More than a fourth of Ireland's manufacturing industries are in Dublin. The city's products include chemicals, clothing, electrical equipment, electronics, furniture, machinery, metal products, printed materials, processed foods, textile products, tobacco, and a dark beer called *stout.* Construction, retail and wholesale trade, transportation and communications, and tourism and other service industries are also important. The city's port handles nearly half of Ireland's foreign trade. Ireland's main airport lies north of the city.

History. Vikings established Dublin in the mid-800's, though a small settlement had previously been on the site. The Viking town was named *Dublin,* from the Irish words *dubh,* meaning *black;* and *linn,* meaning *pool.* The name may refer to a pool of dark water in a branch of the River Liffey. The branch is now filled in by land. The Vikings built Christ Church Cathedral in the 1000's. Norman soldiers from England captured Dublin in 1170. The Normans erected St. Patrick's Cathedral and also built Dublin Castle. The castle was the center of British rule in Ireland for over 700 years.

© Richard Laird, FPG

Dublin stands at the mouth of the River Liffey. O'Connell Bridge, a major Dublin landmark, spans the river. The bridge is named for Daniel O'Connell, an Irish patriot.

Dublin expanded greatly during the 1700's. Although Ireland was controlled by England, an Irish parliament met in Dublin. Manufacturing and trade increased, and the city's cultural life flourished.

Dublin played an important part in most of the major events of Irish history. Fighting in the city during a rebellion against the British in 1916 caused much destruction in Dublin. Much property also was destroyed in the early 1920's, during Ireland's war of independence from Britain and a civil war that followed it.

During the rest of the 1900's, the Dublin area grew steadily. Some valuable old buildings were destroyed to make room for new construction. Suburbs expanded into the surrounding countryside. Today, city leaders face the problem of preserving as much as possible of what is valuable from the past while scheduling further growth for Dublin. Desmond A. Gillmor

See also **Ireland** (pictures).

Dublin, *DUHB lihn,* University of, more generally known as Trinity College, Dublin, was founded in 1592 under a charter granted by Queen Elizabeth I. The financial support of this university came from funds and property given by James I. The university has faculties of arts, science, business, economic and social studies, engineering and systems sciences, and health sciences.

Critically reviewed by the University of Dublin

Dubnium is an artificially produced radioactive element with 105 protons—that is, with an *atomic number* of 105. Scientists have discovered nine *isotopes* of dubnium, forms of the element with the same number of protons but different numbers of neutrons. The *atomic mass numbers* (total numbers of protons and neutrons) of these isotopes range from 255 to 263. The most stable isotope has a mass number of 262 and a *half-life* of 34 seconds—that is, due to radioactive decay, only half the atoms in a sample of isotope 262 would still be atoms of that isotope after 34 seconds.

In 1968, scientists at the Joint Institute for Nuclear Research in Dubna, near Moscow, claimed that they had been the first to produce the element. Dubna was then part of the Soviet Union and is now in Russia. In 1970 and 1971, the scientists presented additional claims. They had bombarded americium, whose atomic number is 95, with neon, whose atomic number is 10. In 1970, researchers at the Lawrence Radiation Laboratory (now Lawrence Berkeley National Laboratory) in Berkeley, California, made a rival claim. The Berkeley researchers had bombarded californium, whose atomic number is 98, with nitrogen, which has an atomic number of 7.

In 1986, the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Pure and Applied Physics formed a working group to review the histories of the elements with atomic numbers from 101 to 109. The group concluded that the 1970 Berkeley claim and the 1971 Dubna claim were equally convincing. In 1993, IUPAC accepted the group's recommendation that the discovery of the element be shared by the institutions. Disagreements about what to name the element delayed an official naming until 1997, however.

Dubnium is named after the Dubna laboratory. The chemical symbol for the element is Db. Before being named, dubnium had commonly been referred to as *element 105.* Richard L. Hahn

Dubois, *dyoo BWAH,* **Eugène** (1858-1941), was a Dutch anatomist and physical anthropologist. While in Java in 1891-1892, he discovered the fossilized bones that he later named *Pithecanthropus erectus,* or *the ape-man that walked erect* (see **Java fossils**). His discovery led to the theory of a single "missing link" in the chain of evolution joining apes and human beings. Later discoveries have led scientists to believe that Pithecanthropus is only one form among many in the human evolutionary process. David B. Stout

Du Bois, *dyoo BWAH,* **Guy Pène,** *gee pehn* (1884-1958), was an American painter and art critic. During the 1920's and 1930's, he produced his best-known paintings. These pictures realistically and often satirically portrayed stylish women and stout, self-confident businessmen relaxing in art galleries, nightclubs, restaurants, and theaters. Du Bois used sharp, bright colors and made his figures sleek, stiff, and sculptural.

Du Bois was born in New York City. For much of the period from 1913 to 1922, he edited a magazine called *Arts and Decoration.* Du Bois wrote many essays supporting American art and defending the values of realism and social observation in painting. His son, William Pène Du Bois, was a noted writer and illustrator of books for children. Sarah Burns

Du Bois, *doo BOYS,* **W. E. B.** (1868-1963), was one of the most important leaders of African American protest in the United States. During the first half of the 1900's, he became the leading black opponent of racial discrimination. He also won fame as a historian and sociologist. Historians still use Du Bois's research on blacks in American society.

Du Bois was probably the first African American to express the idea of *Pan-Africanism.* Pan-Africanism is the belief that all people of African descent have common interests and should work together to conquer prejudice. In 1900, Du Bois predicted that humanity's chief problem of the new century would be "the color line."

William Edward Burghardt Du Bois was born in Great Barrington, Massachusetts. He graduated from Fisk University in 1888. In 1895, he became the first African American to receive a Ph.D. degree at Harvard University. From 1897 to 1910, Du Bois taught history and economics at Atlanta University. He attended the First Pan-African Conference in London in 1900. He later organized Pan-African conferences in Europe and the United States. Du Bois received the Spingarn Medal in 1920 (see **Spingarn Medal**).

Du Bois strongly opposed the noted African American educator Booker T. Washington. Washington believed that blacks could advance themselves faster through hard work than by demands for equal rights (see **Washington, Booker T.**). However, Du Bois declared that African Americans must speak out constantly against discrimination. According to Du Bois, the best way to defeat prejudice was for college-educated blacks to lead the fight against it. Many of Du Bois's ideas appear in a collection of essays called *The Souls of Black Folk* (1903). Du Bois's other works include *Black Reconstruction in America* (1935) and *The Autobiography of W. E. B. Du Bois* (1968).

Wide World

W. E. B. Du Bois

To fight racial discrimination, Du Bois founded the Niagara Movement in 1905 (see **Niagara Movement**). In 1909, he helped found the National Association for the Advancement of Colored People (NAACP). From 1910 to 1934, he was editor of the NAACP magazine *The Crisis.* Du Bois left the NAACP in 1934 and returned to the faculty at Atlanta University. From 1944 to 1948, he again worked for the NAACP. After 1948, Du Bois became increasingly dissatisfied with the slow progress of race relations in the United States. He came to regard Communism as a solution to the problems of blacks. In 1961, Du Bois joined the Communist Party and moved to Ghana. Elliott Rudwick

See also **African Americans** (The rise of new black leaders; picture).

Additional resources

Byerman, Keith E. *Seizing the Word: History, Art, and Self in the Work of W. E. B. Du Bois.* Univ. of Ga. Pr., 1994.
Lewis, David L. *W. E. B. Du Bois.* 2 vols. Henry Holt, 1993, 2000.
Troy, Don. *W. E. B. Du Bois.* Child's World, 1999. Younger readers.

Dubos, *doo BAWS* or *doo BOH,* **René Jules,** *reh NAY zhool* (1901-1982), a French American microbiologist, pioneered in the development of antibiotics, a type of drug used to treat infections. In 1939, Dubos developed tyrothricin, the first commercially produced antibiotic, from a substance made by soil bacteria. His work led other researchers to develop the antibiotics penicillin and streptomycin.

Dubos became an advocate of the science of ecology. His investigations on tuberculosis in the 1940's led him to think and write broadly about human relationships to both the natural and social environments. He shared the 1969 Pulitzer Prize for general nonfiction for *So Human an Animal* (1968).

Dubos was born in Saint-Brice, France, near Paris. In 1927, he earned a Ph.D. degree from Rutgers University and joined the Rockefeller Institute for Medical Research (now Rockefeller University). He became a United States citizen in 1938. Kenneth R. Manning

Dubuffet, *dyoo byoo FEH,* **Jean,** *zhahn,* (1901-1985), was a French artist known for the primitive style of his works. Dubuffet's style draws its chief inspiration from crude wall drawings called *graffiti* and the art produced by children, the mentally ill, and nonindustrial cultures.

Dubuffet was extremely interested in the materials used in painting. In many of his pictures, he used unusual combinations of substances such as sand, gravel, cement, glue, and tar to achieve especially rough textures. For example, he used plant leaves to create *The Cardener.* He produced other works by cutting up painted canvases and reassembling the pieces. Dubuffet often used simple or crude images to shock people who were used to beautiful pictures.

Dubuffet was born in Le Havre. He studied art as a young man but worked as a winemaker until he seriously devoted himself to art in 1942. He helped bring the return of recognizable subject matter to painting at a time when abstract art was popular. Pamela A. Ivinski

Dubuque, *duh BYOOK,* Iowa (pop. 57,686; met. area pop. 89,143), is a port city on the west bank of the Mississippi River, opposite the Illinois-Wisconsin border. For location, see **Iowa** (political map). Dubuque was named for Julien Dubuque, who began to mine lead there in 1788. Lead mining and fur trading have been replaced by machinery manufacturing, meat packing, and tourism as the chief industries. Businesses in the city also produce plumbing supplies, furniture, fertilizers, and dairy products; and sell data processing services, chiefly to medical facilities. Clarke College, Loras College, the University of Dubuque and its theological seminary, and Wartburg Theological Seminary are in the city. Tourist attractions include greyhound races, riverboat gambling, and paddle-wheel riverboat rides. Dubuque was first settled in 1833. A town government was organized in 1837. Iowa's first newspaper was published there in 1836. The city has a council-manager government. Amy K. Gilligan

Dubuque, *duh BYOOK,* Julien (1762-1810), a French-Canadian adventurer, was the first white person to settle in Iowa. He began mining lead ore in 1788 along the Mississippi River near the present city of Dubuque. He called his claim "The Mines of Spain" and received a title to it from the region's Spanish governor. He maintained good relations with the Indians who lived in the area. Dubuque was born in what is now the Canadian province of Quebec. Dan L. Flores

Ducat, *DUHK uht,* is a coin first issued by Roger II of Sicily, Duke of Apulia, in the mid-1100's. It was called a ducat because it was issued by authority of a duchy. Later the coin was used in all southern European countries, either in silver or in gold. The silver ones were worth between 75 cents and $1.10, and the gold ones, $1.46 to $2.32. Burton H. Hobson

Duccio di Buoninsegna, *DOOT choh dee BWAW neen SAY nyah* (1250?-1319?), was the first great painter from Siena, Italy. He became noted for the graceful faces and the soft drapery of his figures. His painting grew out of the earlier Gothic and Byzantine styles, while anticipating the more humanistic art of the Renaissance. From 1308 to 1311, he painted *The Maestà,* the great altarpiece of the cathedral in Siena. It shows the Madonna enthroned, surrounded by angels and saints. Duccio also created miniature paintings for books. He was born in Siena. See also **Jesus Christ** (picture: Jesus restored a blind beggar's sight). Vernon Hyde Minor

Duchamp, *doo SHAHN,* **Marcel** (1887-1968), was a French-born artist and a leader of the modern movement in art. Duchamp created works that challenged the traditional definition of art. His unconventional approach helped to develop an atmosphere of creative freedom for other artists and has continued to be influential.

Duchamp's best-known painting is *Nude Descending a Staircase, No. 2* (1912). The depiction of the human figure as a sequence of planes shows the influence of a style called Cubism that was developed about 1910 in France. This painting first shocked Duchamp's older artistic colleagues in France in 1912. It caused an even greater sensation in 1913 when it was displayed at the New York Armory Show, the first large exhibition of modern art in the United States. The painting baffled and outraged many viewers, to whom it symbolized the unintelligibility of modern art.

Many of Duchamp's works were simply everyday objects that he gave titles and exhibited as art. He called these works *ready-mades.* Duchamp's most controversial ready-made was a common urinal that he titled *Fountain* and signed with the name "R. Mutt." By wittily designating ordinary objects as works of art, he hoped to make people examine their own standards of art.

The most important and complex work of Duchamp's career is the unfinished *The Bride Stripped Bare by Her Bachelors, Even,* sometimes known as the *Large Glass.* In this work of oil paint, wire, and lead foil enclosed in glass, Duchamp explored such themes as sexuality and the increasing mechanization of human life.

Duchamp was born in Blainville, France, near Rouen. In 1904, he went to Paris, where he met artists who later led modern art movements. Duchamp shared many ideas with artists known as Dadaists and Surrealists, but he was not identified exclusively with any group. He settled in the United States in 1942. Pamela A. Ivinski

See also **Dadaism; Surrealism.**

Du Châtelet, Marquise. See **Châtelet, Marquise du.**

Duchess. See **Duke.**

Oil painting on canvas (1912); Philadelphia Museum of Art, Louise and Walter Arensberg Collection

Nude Descending a Staircase, No. 2, is Marcel Duchamp's most famous painting. It caused a sensation at the Armory Show of modern art in New York City in 1913. The painting shows motion by blending a series of movements into one picture.

Dr. Paul A. Johnsgard

A wood duck and her ducklings stay close together so she can protect them from enemies. Most ducklings can swim on the day they are born, but they cannot fly for several weeks.

Duck is a bird with waterproof feathers and webbed feet. Ducks are related to geese and swans. But ducks have shorter necks and wings and flatter bills, and they quack or whistle rather than honk. Male ducks are called *drakes,* and females are called *ducks.*

Ducks live throughout the world in wetlands, including marshes and areas near rivers, ponds, lakes, and oceans. They inhabit arctic, temperate, and tropical regions for some or all of the year. Many kinds of ducks migrate long distances annually between their breeding grounds, where they rest and raise their young, and their wintering areas, where the water does not freeze. Some ducks migrate thousands of miles.

Most ducks are good to eat. Farmers raise the ducks that people buy to eat at home and in restaurants. Duck farming is a profitable business on Long Island, New York, and in the state of Washington, as well as in many parts of Europe, Australia, and New Zealand. Hunters also kill many kinds of wild ducks for food. But the sale of wild game is against the law in a number of countries, including the United States and Canada.

The features of a duck

Ducks spend a lot of time in water, where their webbed feet serve as paddles for swimming and diving. They are graceful on water, but waddle clumsily when walking on land because their legs are set on the sides and toward the rear of the body. Most common wild ducks weigh from 2 to 4 pounds (0.9 to 1.8 kilograms), but some of the smaller species weigh less than 1 pound (0.45 kilogram).

The various kinds of ducks get their food in different ways, depending on their body features. Some ducks extend their long necks down through shallow water to pick food off the bottom. Others dive for food in deep water. Ducks that sift food have wide bills with edges. These edged bills strain seeds and such tiny animals as insects from the water. Some ducks have short, wedge-shaped bills that they use to pry barnacles from rocks or to open or crush clams. Others have long, narrow bills with sawlike edges for catching and holding fish.

Ducks waterproof their feathers. They use their bills to rub the feathers with a waxy oil from a gland at the upper base of the tail. Under the oiled feathers is a layer of soft, fluffy feathers called *down.* Down helps insulate a duck's body by trapping air under the outside feathers.

Most drakes have bright-colored feathers. Their colors include green, blue, red, and chestnut. But drakes of some species are mostly black and white. Most females are brown and can hide by blending with the surroundings when incubating eggs or taking care of ducklings.

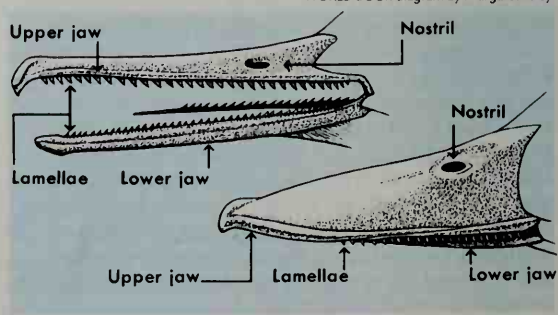
The life of a duck

Ducks seek mates during winter or during spring migration. The bright colors of the drakes attract females. A female usually leads her drake to the breeding grounds during the spring migration, often returning to the same wetland where she was hatched. The ability of ducks and other birds to return to the same places each year is called *homing behavior.* Once on the breeding grounds, males of several duck species defend a small territory from which they drive away other males or oth-

Two types of duck bills

Mergansers have narrow bills, *top,* with toothlike edges to hold fish. Dabbling ducks have short, broad bills for prying, *bottom.*

WORLD BOOK diagram by Margaret Estey



Facts in brief

Names: *Male,* drake; *female,* duck; *young,* duckling; *group,* flock.
Incubation period: 23 to 36 days, depending on species.
Number of eggs: 5 to 12, depending on species.
Length of life: Most ducks live less than 2 years, though some individuals may live more than 25 years in the wild.
Where found: All parts of the world except Antarctica.

er pairs of their own species. Females build nests in clumps of grass or reeds, under bushes, or in tree holes.

Ducklings. The female duck lays from 5 to 12 eggs. After she starts to sit on the eggs to warm and protect them, the drake leaves to join other males. The ducklings hatch from three weeks to a month later.

North American redhead ducks may lay eggs in the nests of other species, relying on the other ducks to hatch the eggs and care for the young. Most ducklings look alike, and the new mother usually accepts them.

Ducklings can run, swim, and find food for themselves within 36 hours of hatching. A group of ducklings is called a *brood.* A mother duck keeps her brood together so she can protect it from predators. Animals that prey on ducklings include turtles, minks, raccoons, hawks, and large fish. Mother ducks keep their broods warm by covering them, especially at night. Sometimes the ducklings from one brood mix with another. As a result, some females end up with broods of 15 to 25 ducklings, while others have only 2 or 3. Ducklings grow quickly and have most of their feathers in about a month. They are able to fly in five to eight weeks.

Food. Ducks that feed at the water surface are called *dabbling ducks.* They eat mostly wetland plants, including the seeds of aquatic weeds, grasses, sedges, and rushes. They also eat insects and other small animals that they find on or under the water. *Pochard ducks* dive to the bottom for roots, seeds, snails, insects, and small clams. In fresh water, pochards and dabbling ducks may eat many kinds of insects, including beetles, bugs, and dragonflies. In salt water, they feed on snails, barnacles, shrimp, and mussels, as well as on plants. *Wood ducks* eat acorns, small fruits, insects, and seeds.

Mergansers are ducks that eat mostly fish, which they

Types of ducks Scientists classify ducks into eight groups called *tribes.* Members of six of these tribes appear in this illustration. They are the dabbling ducks, pochards, perching ducks, sea ducks, shelducks, and stiff-tailed ducks. The other two tribes are the steamer ducks and the torrent duck.

Shelduck illustration by John F. Eggert; other illustrations by Athos Menaboni

Dabbling ducks *(Anatini)*

Mallard
Anas platyrhynchos
Found in Northern Hemisphere
(28 inches, or 71 centimeters)

Pochards *(Aythyini)*

Greater scaup
Aythya marila
Found in Northern Hemisphere
(20 inches, or 51 centimeters)

Perching ducks *(Cairinini)*

Mandarin duck
Aix galericulata
Found in eastern Asia and Japan
(20 inches, or 51 centimeters)

Sea ducks *(Mergini)*

Red-breasted merganser
Mergus serrator
Found in polar region, Northern Hemisphere
(23 inches, or 58 centimeters)

Shelducks *(Tadornini)*

Common shelduck
Tadorna tadorna
Found in Europe and Asia
(24 inches, or 61 centimeters)

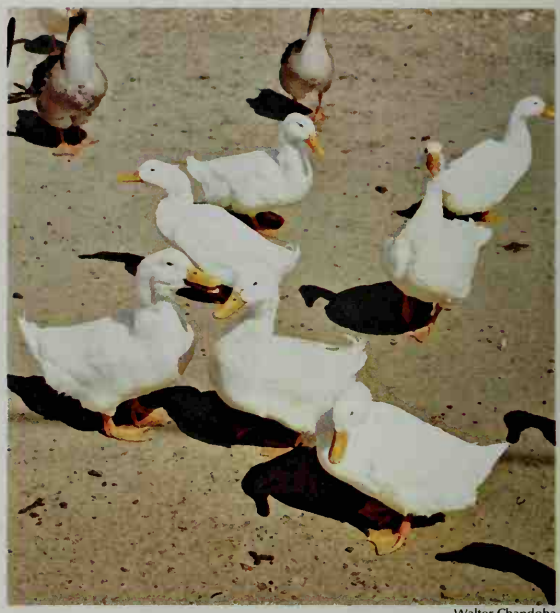
Stiff-tailed ducks *(Oxyurini)*

Ruddy duck
Oxyura jamaicensis
Found in North and South America and West Indies
(17 inches, or 43 centimeters)

catch in either salt water or fresh water. *Eiders* and other sea ducks pull crabs, barnacles, and mussels off rocks and weeds. They dig snails, cockles, and clams from the bottom, and they also catch fish.

Habits. Once the female duck has nested, the drake usually leaves her and joins other drakes to *molt* (lose their old feathers). The drakes lose their bright colors and for several weeks have a brown color like that of the females. During this molt only, the drake also loses his flight feathers and cannot fly. He molts again in early fall and regains his bright mating colors. After her ducklings are well grown, the female also molts and replaces all her feathers.

After growing new feathers and after the young learn to fly, the ducks gather in flocks on large lakes, marshes, or coastal areas to migrate to their wintering grounds. Large *staging flocks* may feed in grain fields for several weeks to build up energy reserves for the long migratory flight. Ducks frequently fly in long lines or "V" formations. Flocks use the same summer and winter areas year after year, even stopping to rest at the same spots along the way. Some ducks fly only a short distance. Others make long flights—some even travel from Canada to Central and South America.



Walter Chandoha

White Pekins are important commercially raised ducks.

Kinds of ducks

Scientists generally classify ducks into eight *tribes* (groups), all of which are described in this section. The scientific name of the tribe appears in parentheses after the common name.

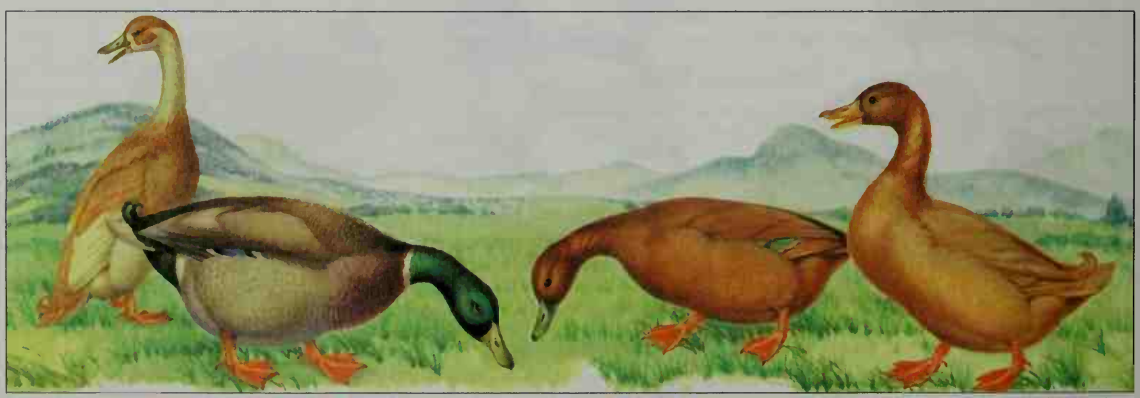
Dabbling ducks (Anatini) include mallards, black ducks, pintails, baldpates, gadwalls, teals, and shovelers. These birds tip bottom-up in shallow water, stretching their necks to feed on the bottom. They take off from water in quick jumps. Each kind of dabbling duck has a specific colored pattern on its wings called the *speculum,* which can identify the species.

Nearly all domestic ducks are dabbling ducks that were bred from wild mallards. White Pekin ducks, which weigh about 8 pounds (3.6 kilograms), rank as important commercially raised ducks.

Pochards (Aythyini) include canvasbacks, redheads, ringnecks, and greater and lesser scaups. They swim underwater with wings closed and legs sticking out to the sides. They have short wings and their legs are closer to the rear of the body than those of most other ducks. Pochards typically dive to feed below the water surface. They run along the surface of the water to get airborne.

Perching ducks (Cairinini) include wood ducks, mandarin ducks, and muscovy ducks. They are extremely colorful ducks of eastern North America and the tropical regions of Africa, Asia, and Central and South America. They often perch in trees.

Sea ducks (Mergini) include mergansers, eiders, scoters, old squaws, harlequins, buffleheads, and goldeneyes. Mergansers have long, narrow bills with sawlike edges to hold fish. Old squaws dive deeper—up to 180 feet (55 meters)—than any other water bird. Eiders produce down that is valuable as insulation in bedding and winter clothing. The Labrador duck, the only extinct duck of North America, was a sea duck.



WORLD BOOK illustration by Athos Menaboni

Most kinds of domestic ducks in the United States were bred from wild mallards. Common species besides the White Pekin include, *left to right,* the Indian Runner, the Rouen, the Khaki Campbell, and the Buff. Duck farms supply domestic ducks to restaurants, stores, and homes.

Shelducks (Tadornini) consist of a few species of bulky, short-billed ducks. Both sexes have similar plumage and the young are covered with black and white down. They live in Europe, Africa, and Asia.

Steamer ducks (Tachyerini) consist of a small group of marine ducks with heavily built bodies and short wings. These ducks live in southern South America.

Stiff-tailed ducks (Oxyurini) have spiky tail feathers that help them steer underwater in search of food. The ruddy duck is the only stiff-tailed duck found in the United States. This small duck lays eggs about twice as large as chicken eggs. Another stiff-tailed duck, the masked duck, lives in Mexico and Central and South America.

The torrent duck (Merganettini), a single species, lives along rivers throughout much of South America's Andes Mountains. Males have predominantly black, gray, and white coloring. Females have mostly gray feathers on their head and back, with rich brownish coloring on their undersides.

Protection of ducks

Many countries regulate the number of ducks that hunters may kill. Refuge areas protect important duck environments. However, the destruction of their wetland habitats remains a major threat to ducks. Duck hunters buy special stamps to raise money to help protect wetlands from being drained. Rodger D. Titman

Scientific classification. Ducks are in the class Aves and in the order Anseriformes. They belong to the family Anatidae.

Related articles in *World Book* include:

Canvasback	Mallard	Swan
Eider duck	Merganser	Teal
Gadwall	Pintail	Wigeon
Goose	Shoveler	Wood duck
Hunting		

Duck hawk. See Falcon (The peregrine falcon).

Duckbill. See Platypus.

Duckbilled dinosaur. See Hadrosaur.

Ducking stool was a form of punishment usually given to "witches and nagging women" in England and the American Colonies from the 1600's to the early 1800's. The ducking stool was a chair fastened to the end of a long plank extended from the bank of a pond or stream. The victim of the punishment was tied securely to the chair and *ducked* (plunged) into the water several times. John W. Ifkovic

Duckweed is the name of several species of tiny plants that float on pools and ponds. A duckweed has no ordinary stem or true leaves. It consists of a flat green structure, usually with a single hairlike root underneath. The *common duckweed* is the smallest flowering plant known. It measures only $\frac{1}{16}$ to $\frac{3}{16}$ inch (1.6 to 4.8 millimeters) long. Duckweeds are sometimes grown as food for ducks and fish. James D. Mauseth

Scientific classification. Duckweeds belong to the duckweed family, Lemnaceae. The scientific name for the common duckweed is *Lemna minor*.

Ducted propeller is a propeller that turns within a cylinderlike device called a *duct*. Ducted propellers are used primarily on air cushion vehicles. Putting a propeller inside a duct makes the propeller more efficient. The duct captures air that is normally thrown to the side by the propeller. This action increases the air pressure behind the propeller blades and increases the propeller's driving force. The increased thrust that is provided by a ducted propeller permits manufacturers to reduce the size of the propeller. Ducted propellers also operate more quietly than do propellers without ducts. See also **Air cushion vehicle.** John D. Bogus

Ductility, *duhk TIHL uh tee,* is the ability of certain solids to undergo permanent changes in shape without breaking. For example, a piece of copper can be drawn to make a thin wire. But the shape of a brick cannot be permanently changed except by breaking it.

Ductility is a valuable property of many metals, including aluminum, gold, iron, nickel, and silver. These metals can be drawn into wire, hammered into various shapes, or rolled into sheets. The term *malleability* is often used in place of ductility to describe the property of metals that allows them to be hammered into thin sheets. Metals are not the only ductile substances and not all metals are ductile. For example, modeling clay is a ductile nonmetallic substance and impure tungsten is a nonductile metal. Johannes Weertman

See also **Malleability.**

Dude ranch is a Western-style ranch that receives paying guests. These guests are usually city dwellers who get little physical activity and contact with nature. Three brothers, Howard, Alden, and Willis Eaton, are believed to have established the West's first dude ranch near Sheridan, Wyoming, in 1904.

Some dude ranches are regular cattle or sheep ranches that entertain a few guests as a sideline. But other ranches are devoted entirely to the business of entertaining *dudes* (guests). Most of the dude ranches are in the "cow country" of Montana, Wyoming, Arizona,

Bell Aerospace Textron

Ducted propellers power these high-speed amphibious landing craft used by the United States Navy to carry troops and equipment. Putting a propeller in a cylinderlike device called a *duct* makes the propeller more efficient and provides quieter operation than a propeller without a duct.

California, Nevada, Colorado, New Mexico, and Oregon. Guests go on horseback rides along mountain trails, hunt, fish, and in some cases help with the livestock.

Critically reviewed by the Dude Ranchers' Association

Dudley, Robert. See Leicester, Earl of.

Dudley, Thomas (1576-1653), was a colonial governor of Massachusetts. Born in Northampton, England, he became steward to the powerful Earl of Lincoln, whose estates he managed. He sailed with John Winthrop on the *Arbella* in 1630 as deputy governor of the colony. He became governor four times. A Puritan of the stern and harsh type, he often differed with the tolerant and kind Winthrop. He was a founder of First Church at Charlestown, Mass., and of Newtowne (now Cambridge, Mass.). He was an early promoter and overseer of Harvard College. John W. Ifkovic

Due process of law is a basic principle in the American legal system that requires fairness in the government's dealing with persons. The term *due process of law* appears in the 5th and 14th amendments to the Constitution of the United States. These amendments forbid federal, state, and local governments from depriving a person of "life, liberty, or property, without due process of law." The Supreme Court of the United States has never clearly defined these words, and has applied them to a number of widely different situations.

The idea of due process of law dates from England's Magna Carta of 1215. One article in this document promises that no one shall be deprived of life, liberty, or property, except "by the lawful judgment of his peers or by the law of the land." Some early English *writs* (written legal orders) were designed to bring the government under a rule of law. For example, a writ of *habeas corpus* requires that the government show just cause before it can hold a person in custody. See **Magna Carta; Habeas corpus.**

Through law and custom, various safeguards have been developed in the United States to assure that persons accused of wrongdoing will be treated fairly. These safeguards are sometimes called *procedural due process.* Procedural due process includes the following requirements: (1) The law must be administered fairly. (2) People must be informed of the charges against them and must be given the opportunity for a fair hearing. (3) The person bringing the charges must not be allowed to judge the case. (4) Criminal laws must be clearly worded so that they give adequate warning of the action prohibited. Procedural due process concepts apply to civil and criminal cases.

Courts have also used the "due process" clauses of the 5th and 14th amendments to limit the content of laws, even though there was no procedural unfairness. For example, they have declared unconstitutional some laws restricting personal freedoms and business, on the ground that the laws violate due process of law. This practice involves the *substance* of public policy and is called *substantive due process.* Sherman L. Cohn

See also **Civil rights; Constitution of the United States** (Amendments 5 and 14).

Duel is a form of combat between two armed persons. It is conducted according to set rules or a code, and it is normally fought in the presence of witnesses. From early times through the 1800's, men of high rank settled personal quarrels with weapons. They generally used swords or pistols. Duels resulted from disputes over property, charges of cowardice, insults to family or personal honor, and cheating at cards or dice.

The duel probably originated in the custom of Germanic *judicial combat,* a method of administering justice. In judicial combat, the accused person challenged the accuser to a trial with weapons. The gods were supposed to give victory to the innocent person. Queen Elizabeth I of England was the first to abolish the duel as a form of justice. Later, all civilized countries abandoned the practice. But some private duels are still fought.

Some duels were more deadly than others. About 1800, French honor was satisfied by wounds, but the American dueling code at that time demanded death. The phrase *to give satisfaction* could mean either that blood must be drawn, or that one of the contestants must die. At other times it meant only that the challenged party had faced his enemy's fire.

The man challenged had his choice of weapons. The sword became the main dueling weapon in England and France. Duelists generally used pistols in America. Each duelist chose a friend who was called his *second,* and a surgeon usually attended. To avoid the police, the meeting usually took place in a forest clearing at daybreak. When duelists used pistols, they usually faced each other at an agreed-upon distance and fired on a visible signal or a command.

Dueling was common in the United States up to the mid-1800's. Many famous Americans fought duels. Aaron Burr fatally wounded Alexander Hamilton on July 11, 1804, in a pistol duel. Burr blamed Hamilton for his defeat in an election for governor of New York (see **Hamilton, Alexander**). General Andrew Jackson killed Charles Dickinson on May 30, 1806, in a pistol duel. Jackson challenged Dickinson because Dickinson denounced him in the press. The quarrel started in a dispute over a horse race. Commodore James Barron killed Commodore Stephen Decatur on Mar. 22, 1820, in a pistol duel. Barron claimed Decatur was persecuting him. Henry Clay fought John Randolph on Apr. 8, 1826, in a pistol duel, but neither was hurt. Clay challenged Randolph because Randolph had made insulting remarks about him in the United States Senate (see **Randolph, John** [1773-1833]).

Tennessee outlawed dueling in 1801, and the District of Columbia banned it in 1839. Several other states did so soon after that. Since then, one who kills an opponent in a duel can be tried for murder or manslaughter. Some German students still duel secretly with swords as a sport. They try only to inflict cheek wounds in duels with fellow members of the fencing fraternities in the German universities. Hugh M. Cole

Duff, Sir Lyman Poore (1865-1955), served on the Supreme Court of Canada from 1906 to 1944. During the last 11 years, he was chief justice. Canada became independent from Britain in 1931, and many of Duff's rulings strengthened the nation's central government. He upheld many federal laws challenged by provincial governments in Canada.

During World War II, Duff investigated charges that the government sent poorly equipped and untrained troops to help defend Hong Kong. Over 200 Canadians died and more than 2,000 were captured when Japan took Hong Kong in 1941. Duff's report supported the

government's conduct but drew criticism in Canada.

Duff was born on Jan. 7, 1865, in Meaford, Ontario. He received his law degree from the University of Toronto in 1889. King George V knighted him in 1934.

J. L. Granatstein

Dufferin and Ava, Marquess of (1826–1902), was a successful British diplomat who served as governor general of Canada from 1872 to 1878. As governor general, Dufferin helped convince the province of British Columbia to end its threat to withdraw from Canada during a delay in extending railroad service to the province. He also encouraged the province of Prince Edward Island to become part of Canada. Dufferin later served as British ambassador to Egypt, France, Italy, Russia, and Turkey. He was *viceroy* (ruler) of India from 1884 to 1888.

Dufferin was born on June 21, 1826, in Florence, Italy. His given and family name was Frederick Temple Blackwood. He received his title in 1888. Jacques Monet

Dufy, *dyoo FEE,* **Raoul,** *ra OOL* (1877-1953), was a French artist best known for his lively, decorative paintings. Dufy used bright colors and a linear, graphic style to portray a happy, carefree world. His subjects included festivals, horse races, still lifes, and figures. Dufy also illustrated books and made woodcuts as well as designing fabrics, tapestries, and theater costumes and sets.

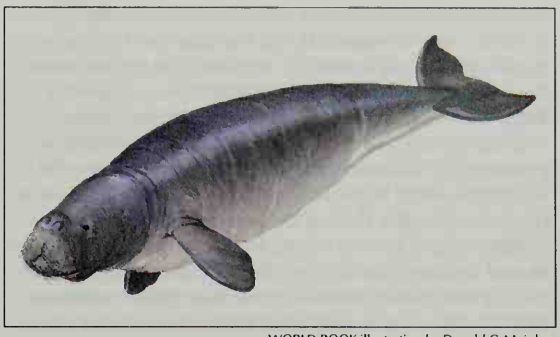
Water color (1932); the Baltimore Museum of Art, Saidie A. May Collection

Dufy's *Le Haras du Pin* shows the bright colors, sketchy details, and cheerful subject matter that typified his work.

Dufy was born on June 3, 1877, in Le Havre. In 1900, he settled in Paris, where he painted briefly in the impressionist style. Dufy first attracted attention when he exhibited brightly colored paintings of scenes from the life of his day with the Fauves (see **Fauves**). He then came under the influence of cubism before developing his own distinctive style. Nancy J. Troy

Dugong, *DOO gahng,* is a plant-eating sea mammal. It lives in shallow, warm coastal waters of the Indian and South Pacific oceans from eastern Africa to northern Australia, Papua New Guinea, and other islands.

A dugong has a blunt, rounded snout with a bristly upper lip. Both the male and the female have two long tusks in the upper jaw, but only those of the male are visible. Most dugongs are brownish or grayish. Like dolphins, the dugong has a streamlined body and a forked tail that propels it through the water. It uses its flippers



WORLD BOOK illustration by Donald C. Meighan

The dugong is an endangered sea mammal.

for maneuvering and to push sea grass near its mouth. The average adult dugong measures about 9 feet (2.7 meters) long and weighs about 600 pounds (270 kilograms). Dugongs can live up to about 70 years.

Dugongs have been hunted for their meat, fat, hides, and bone. They are still hunted in some areas, and some have died as a result of becoming tangled in fishing nets. The dugong is considered an endangered species.

Daniel K. Odell

Scientific classification. The dugong is in the family Dugongidae in the order Sirenia. Its scientific name is *Dugong dugon.*

See also **Manatee; Sea cow; Sirenia.**

Duisburg, *DYOOS boork* (pop. 535,447), is a trading and manufacturing city in the Ruhr region of Germany (see **Germany** [political map]). It is the largest inland port of Western Europe.

Duisburg is built where the Ruhr River flows into the Rhine and is connected with north German ports by the Rhine-Herne Canal. It is a gateway to the factories and mineral deposits of the Ruhr region. The city produces almost half of Germany's iron and steel. Duisburg's other products include chemicals, silks and woolens, soap, and tobacco. Peter H. Merkl

Dukakis, *doo KAHK ihs,* **Michael Stanley** (1933-), was the Democratic presidential nominee in 1988. He lost the election to his Republican opponent, Vice President George H. W. Bush. Dukakis was serving his third term as governor of Massachusetts while he campaigned for the presidency. Before becoming governor, he had been elected to the Massachusetts House of Representatives four times.

Early life. Dukakis, the son of Greek immigrant parents, was born on Nov. 3, 1933, in Brookline, Massachusetts. He graduated from Swarthmore College in 1955. From 1955 to 1957, he served in the United States Army in Korea. Dukakis earned a law degree from Harvard Law School in 1960. In 1963, Dukakis married Katharine (Kitty) Dickson. Their children are John, Mrs. Dukakis's son from a previous marriage; Andrea; and Kara.

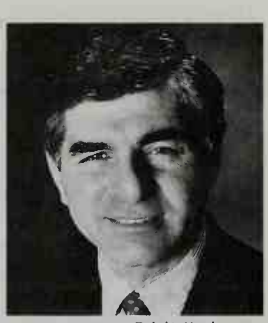
Political career. In 1962, Dukakis was elected to the Massachusetts House of Representatives. He won reelection in 1964, 1966, and 1968. In 1970, he was nominated for lieutenant governor of Massachusetts, but the ticket was defeated.

Dukakis was elected governor of Massachusetts in 1974, defeating incumbent Francis W. Sargent. Under Dukakis, an estimated $500 million deficit in the state

budget was eliminated. But many Massachusetts Democrats were dissatisfied that Dukakis had increased taxes and had cut spending on social programs. He lost the 1978 gubernatorial primary election to Edward J. King, who went on to victory in the general election.

Dukakis faced King again in the 1982 gubernatorial primary. He defeated King and then won the general election against Republican John W. Sears. Dukakis was reelected in 1986. During these terms as governor, Dukakis established a reputation as an effective manager and problem solver. He offered incentives to businesses that participated with the state government on such social programs as job training for welfare recipients. He also increased state tax revenues through stricter, more aggressive collection of taxes.

The 1988 Democratic National Convention nominated Dukakis for president and Senator Lloyd Bentsen of Texas for vice president. Dukakis and Bentsen were defeated by Bush and his running mate, Senator Dan Quayle of Indiana. For the electoral vote, see **Electoral College** (table).



Dukakis Headquarters

Michael Dukakis

Dukakis was criticized for his handling of state finances in the late 1980's, at a time when Massachusetts was encountering severe financial difficulties. A decline in tax revenues and a sluggish state economy had led to large budget deficits. Dukakis did not seek reelection as governor in 1990.

Robert L. Turner

See also **Democratic Party; Bentsen, Lloyd M., Jr.**

Dukas, *dyoo KAH,* **Paul Abraham** (1865–1935), was a French composer, music teacher, critic, and editor. He became best known for *The Sorcerer's Apprentice* (1897), written in a lively symphonic form called a *scherzo.* Dukas was a master of orchestration. He has been praised for the clarity of his music and for his ability to produce a variety of tone colors from different combinations of instruments.

Dukas was born in Paris. He taught at the National Conservatory of Music in Paris for several years. He also served as a music critic and prepared for publication and performance works by such composers as Ludwig van Beethoven, François Couperin, Jean-Philippe Rameau, and Domenico Scarlatti. Dukas composed only a few works in addition to *The Sorcerer's Apprentice.* They include the overture *Polyeucte* (1891), *Symphony in C* (1897), the opera *Ariadne and Bluebeard* (1907), and the ballet *The Peri* (1912). Vincent McDermott

Duke is a European title. It comes from the Latin word *dux* (leader), and is the title next highest to *prince.* In England, there are few dukes outside the royal family, where the sons have the title of Royal Duke. The wife of a duke is a *duchess,* the oldest son is a *lord* with the rank of *marquess,* and younger sons and daughters are called *lords* and *ladies.*

In early days, a duke was a leader in battle, and sometimes a ruler as well. The first English duke was the Black Prince, oldest son of Edward III, who was made Duke of Cornwall in 1337. *Archduke* was a title used by members of the royal family of Habsburg from 1453 until the end of World War I. Ralph A. Griffiths

Duke, James Buchanan (1856-1925), an American businessman and philanthropist, organized the American Tobacco Company in 1890. He set up the Duke Endowment in 1924. He also gave funds to schools, hospitals, orphanages, and the Methodist Church. He was born near Durham, North Carolina. See also **Duke Endowment; Duke University.**

Duke Endowment is a trust fund established in 1924 by James B. Duke, an American businessman. Its purpose is "to make provision in some measure for the needs of mankind along physical, mental, and spiritual lines." The original gift was about $40 million. Income of the endowment is distributed among specifically named beneficiaries in North and South Carolina. These beneficiaries include Duke University, Davidson College, Furman University, and Johnson C. Smith University; nonprofit hospitals and child care institutions; and rural United Methodist churches and retired United Methodist ministers.

The endowment's main offices are at 200 S. Tryon Street, Charlotte, NC 28202.

Critically reviewed by the Duke Endowment

Duke University is a private coeducational school in Durham, North Carolina. It offers undergraduate programs in arts and sciences and engineering. It also has a graduate school and schools of business administration, divinity, environment, law, medicine, and nursing. Courses lead to bachelor's, master's, and doctor's degrees.

The university library contains more than 6 million books and manuscripts. Duke Hospital is a noted teaching and training institution. The 7,700-acre (3,100-hectare) Duke Forest serves as a laboratory for the School of Forestry. The marine laboratory near Beaufort, North Carolina, is used for training and research in marine biology and oceanography.

The school originated in 1838 as an academy. It became Union Institute in 1839, and in 1859 it was renamed Trinity College. The school is named for Washington Duke, an early benefactor of Trinity College. Duke's son, the tobacco millionaire James B. Duke, provided an endowment in 1924 that helped the college become a leading university.

Critically reviewed by Duke University

Dukenfield, William Claude. See **Fields, W. C.**

Dukhobors. See **Doukhobors.**

Dulcimer, *DUHL suh muhr,* is a stringed musical instrument played with wooden hammers. The hammered dulcimer has 42 to 72 metal strings stretched across a flat, wooden box, which is usually trapezoid-shaped.

The Appalachian, or mountain, dulcimer is a different instrument. It is shaped like an hourglass or a teardrop and is held on the player's lap. It has three or four strings, which the player plucks or strums with one hand. The musician controls the pitch by pressing the strings down with the other hand.

The hammered dulcimer is found in many parts of the world, including Asia, Europe, and North America. Its history is well documented back to the mid-1400's. European immigrants brought the instrument to the United

States in the 1800's. The hammered dulcimer gained new popularity during the American folk music movement of the 1960's. André P. Larson

See also Zither.

Dulles, *DUHL uhs,* **John Foster** (1888-1959), was an American lawyer and diplomat who helped formulate United States foreign policy during a long and distinguished career. He won international praise in 1951 as the chief author of the peace treaty between Japan and most of the Allied nations of World War II (1939-1945). He also negotiated the Australian, New Zealand, Philippine, and Japanese security treaties in 1950 and 1951. From 1953 to 1959, Dulles served as secretary of state under President Dwight D. Eisenhower. In this post, he was best known for his unyielding opposition to Communism (see Cold War [To the brink and back]).

Dulles was born in Washington, D.C. He graduated from Princeton University and received a law degree from George Washington University. Dulles was a U.S. delegate to the United Nations from 1946 to 1948 and in 1950. He served as a U.S. senator from New York in 1949. In 2001, Dulles's son Avery Dulles was named a cardinal of the Roman Catholic Church. Stephen E. Ambrose

Duluth, *duh LOOTH* (pop. 86,918), is the third largest city in Minnesota. Only Minneapolis and St. Paul have more people. Duluth is in the northeastern part of the state. It lies on the western shore of Lake Superior where the St. Louis River flows into the lake and forms a natural harbor (see Minnesota [political map]). Duluth and Superior, Wisconsin—which lies across St. Louis Bay—are part of a metropolitan area with a population of 243,815. Duluth is built on a steep slope that rises about 800 feet (240 meters) above the shore of Lake Superior.

Duluth is a transportation center for products of the upper Midwest. The Duluth-Superior harbor is connected to the Atlantic Ocean by way of the St. Lawrence Seaway. It is the busiest of the Great Lakes ports. Facilities along its 47 miles (76 kilometers) of waterfront include iron ore docks, coal docks, and grain elevators. Duluth's most famous landmark, the Aerial Lift Bridge, crosses the Duluth ship canal. The canal was constructed in 1871 by cutting through a sand bar called Minnesota Point. It was built to provide access to the Minnesota portion of St. Louis Bay.

Iron ore and coal are the chief products shipped from Duluth to other parts of the United States. Grain is the main international export. In addition to shipping, the city's important industries include tourism and education. Duluth is also a major medical center. Technology Village, in downtown Duluth, is a center for information technology companies. Other employers include an airplane maintenance facility for a commercial airline and a company that designs and produces small passenger planes. Duluth International Airport, freight railroads, and interstate and regional highways serve the city.

Duluth and its surrounding area make up an attractive vacation center. Skyline Parkway, which run for 25 miles (40 kilometers) along the heights of the city, offers scenic views of the area. The city's steep slope is the setting for the Spirit Mountain ski area. Duluth is the gateway to the scenic North Shore of Lake Superior and well situated for hunting, fishing, sailing, and hiking. The city's annual Grandma's Marathon draws thousands of runners.

Duluth has a symphony orchestra, community theater, and professional ballet company. The Depot—a restored railroad terminal—houses several community museums, the St. Louis County Historical Society, and the Lake Superior Museum of Transportation. The city is the home of the Duluth campus of the University of Minnesota and the College of St. Scholastica.

Duluth was named for Daniel Greysolon, Sieur Duluth (or Du Lhut), a French explorer and trader who visited the site about 1679. In the 1700's, British traders replaced the French traders in the area. In 1817, John Jacob Astor's American Fur Company started a trading post at Fond du Lac, in what is now western Duluth. More people began to come to the area in the 1850's. Duluth was incorporated as a city in 1870. The population fell in the mid-1870's, and Duluth lost its status as a city. By about 1880, Duluth again began to grow swiftly, as lumbering and sawmill activities increased. It was incorporated as a city again in 1887. Another period of growth began in the 1890's, when iron ore shipping developed.

Duluth is the seat of St. Louis County. The city has a mayor-council form of government. David J. Ouse

Duma, *DOO muh,* officially called the State Duma, was the lower house of the Russian legislature in the early 1900's, during the reign of Czar Nicholas II. Nicholas wanted to rule Russia with supreme authority. But Russian liberals demanded an elected legislature to approve laws and taxes. The Russian Revolution of 1905 threatened the czar's government and forced him to grant the liberals' demand.

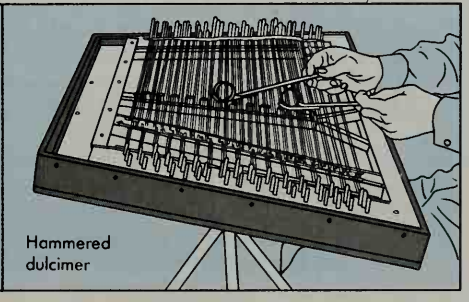
The czar created the Duma in 1906, making it part of a two-house legislature. The State Council, which had been an advisory body to the czar, became the legislature's upper house. Nicholas feared democracy, and so he required that the Duma be indirectly elected in a system that favored people who owned large amounts of property. Women could not vote. The czar appointed half of the State Council's members. The other half were elected by landowners, nobility, clergy, businessmen,

Types of dulcimers

The *Appalachian dulcimer* has three or four strings and is played with the fingers. The *hammered dulcimer* commonly has from 42 to 72 metal strings that are stretched across a trapezoid-shaped box. The player strikes the strings with curved wooden hammers.

WORLD BOOK illustration by Zorica Dabich

WORLD BOOK illustration by Arthur Grebetz



and university professors. Laws and taxes had to be approved by the czar, the State Council, and the Duma.

The first Duma, which opened in 1906, was too radical for Nicholas, and he disbanded it. The second, elected in 1907, was even more hostile to the czar, and he soon dismissed it. Nicholas changed the election procedures in June 1907 to further strengthen the role of people with property. As a result, the third Duma was more conservative, and it served a full term, from 1907 to 1912. It often criticized Nicholas but worked with him on agricultural reform and public education.

The fourth Duma, elected in 1912, attacked the czar's conduct of World War I (1914-1918) and sought more power for itself. It helped bring about Nicholas' *abdication* (resignation from the throne) in March 1917. But the fourth Duma had little support among the people and was dissolved in October 1917 without completing a full term. In November 1917, Communists gained control of Russia and abolished the Russian legislature.

In 1993, Russia adopted a new constitution that created a 450-member State Duma. This body is the lower house of a national legislature known as the Federal Assembly. Joseph T. Fuhrmann

See also **Nicholas II** (of Russia); **Russia** (Government).

Dumas, *doo MAH,* **Alexandre,** *a lehk SAHN druh,* **père** (1802-1870), was a French novelist and playwright. His son was the French author Alexandre Dumas *fils* (son). *Père* means *father* in French. Dumas chose unusual, real characters for his novels and plays. He often used their memoirs for historical detail and changed their lives into exciting tales of adventure.

Dumas is best known for his famous romantic novels *The Three Musketeers* (1844) and *The Count of Monte Cristo* (1844-1845). Dumas continued the story of *The Three Musketeers* in *Twenty Years After* (1845) and *The Viscount of Bragelonne* (1848-1850).

Although Dumas is best known for his novels, his plays are more important in the history of French literature. Dumas created two types of plays, the historical drama and the contemporary drama set in his own time. Dumas's historical plays include *Henry III and His Court* (1829) and *The Tower of Nesle* (1832). His first contemporary drama was *Antony* (1831). All three are melodramatic stories of passion and murder. These plays were among the earliest and most successful plays of the French romantic movement (see **Romanticism**). *Kean* (1836), one of Dumas's best-known plays, is about the English Shakespearean actor Edmund Kean, who lived during the early 1800's. It treats the nature of dramatic genius and the actor's alienation from society.

Dumas had many collaborators. The one who helped him the most was August Maquet. He wrote many novels with Dumas, including *The Three Musketeers,* though scholars disagree about how much Maquet contributed to them. Dumas also wrote histories, travelogues, and memoirs.

Dumas tried to shape his works to changing literary tastes. But during France's Second Empire (1852-1870), the quality of his work and his popularity fell. He was born in Villers-Cotterêts. Thomas H. Goetz

Dumas, *doo MAH,* **Alexandre,** *a lehk SAHN druh,* **fils** (1824-1895), was a French writer. His father was the French author Alexandre Dumas *père* (father). *Fils* is the French word for *son.* See **Dumas, Alexandre, père.**

Dumas was born in Paris, the illegitimate son of Dumas *père.* The shame of illegitimacy caused the younger Dumas much suffering. It helps to explain his concern with the victims of society and his emphasis on stable family life in his works.

Dumas wrote both novels and plays, but his fame rests chiefly on his plays. His first play, *The Lady of the Camellias* (often called *Camille*), was a great success when performed in 1852. The tragic love story is set in the fashionable Parisian society of Dumas's time. The author based the play on his novel of the same name, which was published in 1848. Giuseppe Verdi used the story for his opera *La Traviata.*

Dumas believed that plays should teach social and moral lessons. He defended the family in *The Wife of Claude* (1873) and *Denise* (1885). He attacked wickedness, but also asked forgiveness for those who repent—as in *The Ideas of Madame Aubray* (1867). His plays, therefore, have a preaching tone, but they are well-constructed and often witty and give a good picture of French upper-class society of the time. Thomas H. Goetz

Du Maurier, *doo MAWR ee AY,* **Daphne** (1907-1989), was an English writer best known for her romantic novels. She was more interested in designing plots full of mystery and suspense than in creating complex characters. Her most popular novel, *Rebecca* (1938), is about a sensitive young woman disturbed by the memory of her husband's first wife. Her other novels include *Jamaica Inn* (1936), *Frenchman's Creek* (1941), and *My Cousin Rachel* (1951). She also wrote an autobiography, *Myself When Young* (1977), and three plays.

Du Maurier was born in London and received an exclusive private education in England and France. Her family biography, *The Du Mauriers* (1937), describes her father, actor and theater producer Gerald Du Maurier, and her grandfather, artist and novelist George Du Maurier. She lived most of her life on the coast of Cornwall, the romantic setting of many of her works. Queen Elizabeth II made Du Maurier a Dame Commander in the Order of the British Empire in 1969. She became known as Dame Daphne Du Maurier. K. K. Collins

Du Maurier, *doo MAWR ee AY,* **George** (1834-1896), was an English artist and novelist. He drew numerous black-and-white cartoons that satirized English society during his time. Most of these appeared in *Punch,* a weekly comic magazine. Du Maurier also illustrated the works of such important authors as Thomas Hardy, Henry James, and William Makepeace Thackeray.

Du Maurier wrote three highly dramatic novels that contain an unusual blend of fantasy and autobiography. *Trilby* (1894), the most popular, is about an artist's model under the power of an evil hypnotist named Svengali. Du Maurier's other novels are *Peter Ibbetson* (1891) and *The Martian* (1896). George Louis Palmella Busson Du Maurier was born in Paris. K. K. Collins

See also **Du Maurier, Daphne.**

Dumbarton Oaks, *duhm BAHR tuhn,* was the name of an international conference held in August-October 1944 at Dumbarton Oaks, an estate in Washington, D.C. The name was also given to the proposals agreed upon at the conference. Thirty-nine delegates from the United States, the United Kingdom, and the Soviet Union met to discuss plans for the creation of an international organization to be called the *United Nations.* After six weeks of

talks, the Soviet delegates, as agreed in advance, left, and delegates from Nationalist China replaced them.

The conference gave more attention to establishing ways to deal with "the maintenance of international peace and security" than it did to setting up agencies to handle economic and social problems. The delegates agreed that provision must be made for the peaceful settlement of international disputes and for the power to enforce decisions. Their main achievement was the planning of a Security Council as the chief agency for settling conflicts and enforcing UN resolutions dealing with matters of war and peace among member states. Most provisions of the Dumbarton Oaks Proposals were put into the UN charter. Robert J. Pranger

See also **San Francisco Conference; United Nations** (The Dumbarton Oaks Conference).

Dumont, Gabriel (1838-1906), served as military leader of the North West Rebellion, a revolt against the Canadian government in 1885. He helped Louis Riel lead the *métis* (persons of mixed white and Indian ancestry) in a fight for land rights. Riel was the métis' political head.

Public Archives of Canada

Gabriel Dumont

Dumont was born in Assiniboia, in what is now southern Manitoba. In the early 1870's, he moved to Saskatchewan. In 1873, Dumont became leader of a métis settlement in Saint Laurent, near Duck Lake. The métis surveyed their property by the traditional French system. Settlers laid out lots in strips so that most bordered a river or a lake. But the Canadian government surveyed land in square lots and rejected the métis surveys. This dispute became the chief cause of the 1885 revolt.

In March 1885, Riel and Dumont formed a temporary government for the métis in Saskatchewan. Dumont's forces defeated mounted police at Duck Lake. Fighting between the métis and Canadian forces ended in May 1885, after Dumont's defeat at nearby Batoche. Dumont escaped. Several years later, the Canadian government granted him amnesty. P. B. Waite

See also **North West Rebellion; Riel, Louis.**

Dún Laoghaire, *duhn LAIR uh* (pop. 54,715), is a town on the east coast of Ireland. It lies 7 miles (11 kilometers) southeast of Dublin (see **Ireland** [political map]). *Dún Laoghaire* means *the fort of Laoghaire* in Gaelic. Laoghaire was an Irish king in the A.D. 400's. Dún Laoghaire is a residential area for people who work in Dublin. It also has some light industries. It is a center of fishing, yachting, and other tourist activities. The town has some Victorian architecture, but most of its buildings are modern.

Originally called Dunleary, the town was renamed Kingstown in 1821. Its development dates from the construction of its harbor, begun in 1817. The town was named Dún Laoghaire in 1920. In 1930, it joined other nearby towns to form a borough. Desmond A. Gillmor

Dunant, *doo NAHN,* **Jean Henri,** *zhahn ahn REE* (1828-1910), a Swiss banker, was the founder of the International Red Cross. As a young businessman, he accidentally saw the battle of Solferino in 1859. He was shocked at the lack of care given the wounded. His book, *Recollections of Solferino* (1862), influenced the rulers of Europe tremendously, and in 1863 the Permanent International Committee was organized in Geneva. In 1864, delegates of 16 countries agreed to the Geneva Convention for the treatment of wounded and prisoners (see **Geneva Conventions**). Dunant went bankrupt and for 15 years his whereabouts was unknown. He was found in 1890, living in an almshouse, and in 1901 shared the first Nobel Peace Prize. He was born in Geneva. See also **Red Cross** (History). Alan Keith-Lucas

Dunbar, Paul Laurence (1872-1906), was one of the most popular American poets of the 1890's and early 1900's. He was the first black American to become nationally popular as a writer of both poetry and fiction. From 1893 to 1905, Dunbar published 14 books, more than any black American before 1950.

Dunbar wrote poetry in standard English about traditional poetic subjects and about the heroes of African-Americans. In some of these poems, he experimented with metrical forms and rhyme schemes. He also wrote comic and sentimental poetry in dialect about black and white Americans. Editors of Dunbar's time preferred his dialect poetry and stories about blacks who enjoy the simple pleasures of life apart from the white world. Dunbar satisfied the demands of the editors but expressed fear that he would be remembered only as a writer of "a jingle in a broken tongue."

Bettmann Archive

Paul Dunbar

Some modern readers criticize Dunbar for only rarely condemning racial stereotypes and discrimination against black Americans. In his poetry, Dunbar usually limited his racial concerns to themes praising blacks rather than attacking whites. He pointed out racial injustices bitterly or satirically in his essays and in stories in such works as *The Strength of Gideon* (1900) and *The Sport of the Gods* (1902), a novel. Dunbar was born in Dayton, Ohio, the son of former slaves. William L. Andrews

Duncan I, *DUHNG kuhn* (? -1040), succeeded his grandfather Malcolm II as king of Scotland in 1034. He made several unsuccessful attempts to expand his kingdom. He also failed to rule all Scotland. Macbeth of Moray, one of Duncan's generals, had a claim to the Scottish throne by right of his wife's royal ancestry. He killed Duncan in a battle near Elgin. *Macbeth,* a play by the English writer William Shakespeare, portrays the events of Duncan's life in a distorted manner (see **Macbeth**). Joel T. Rosenthal

Duncan, *DUHNG kuhn,* **Isadora** (1877-1927), an American dancer, greatly influenced dancing in the 1900's. She rebelled against the rigid, formal training of classical ballet and created an individual form of expression. Influenced by the art of Greece, she often danced barefoot in a loose, flowing tunic. Duncan's dancing was

The Dance Collection, New York Public Library

Isadora Duncan was strongly influenced by classical Greek culture. She usually danced barefoot in a flowing tunic.

inspired mainly by literature and classical music. She based her first dances on poetry. Duncan also used images and forms taken from painting and sculpture. She found further inspiration in nature, and she used dance to mirror natural forms such as waves.

Isadora Duncan was born in San Francisco. She gained great success in Europe, where she first performed in 1899. She lived abroad during most of her career and established schools of dance for children in France, Germany, and Russia. Duncan's ideas inspired later generations to seek their own forms of dance expression. Selma Landen Odom

See also **Dance** (Modern dance).

Duncan, Robert (1919-1988), was an American poet. He was associated with a group of poets who worked during the 1950's at Black Mountain College, an experimental school in North Carolina. These poets sometimes are called the *Black Mountain poets.* Duncan was also a major figure in the San Francisco Renaissance, a cultural and artistic movement during the 1950's.

Duncan wrote of the power of pagan, Christian, and Jewish myth to restore meaning to modern life. His other related themes are love, the imagination, history, and the recovery of a spontaneous and magical language.

Duncan's most important early collections of poems are *The Opening of the Field* (1960) and *Roots and Branches* (1964). In these and other works, he used symbolic material and references to various ancient mythologies. Duncan increasingly dealt with political and social issues in his later works. For example, in the collection *Bending the Bow* (1968), he attacked American participation in the Vietnam War. *Ground Work: Before the War* (1984) and *Ground Work II: In the Dark* (1987) include poems inspired by medieval and Renaissance works. They also confront the evils of war and injustice. Duncan was born in Oakland, California, on Jan. 7, 1919.

Steven Gould Axelrod

Dundee (pop. 165,548) is a major industrial center of Scotland and one of its largest cities. Dundee lies in east-central Scotland on the Firth of Tay—an arm of the North Sea. For location, see **Scotland** (political map).

Landmarks of Dundee include a huge civic building called Caird Hall, an old castle called Dudhope Castle, and the University of Dundee. Two bridges cross the firth, connecting Dundee with the other bank.

Dundee's many industries include shipping, oil rig servicing, and the manufacture of candy, marmalade, and sacks and other items made from jute. Other products include cash registers, computers, and tires.

Dundee has been an important trading center since the Middle Ages. It grew rapidly during the 1800's, and what was then the world's largest jute industry was established there. During the 1900's, the importance of Dundee's jute products industry and some other traditional industries declined. But a number of new industries were established in the city. H. R. Jones

Dune is a mound or ridge of loose sand that has been deposited by the wind. Dunes are common in all sandy regions. They are found along seacoasts, near rivers and lakes, and in deserts. Dunes may be long and narrow or shaped like a crescent. Some have three or more ridges that extend from a high central peak. In some areas, large dunes reach heights of 1,000 feet (300 meters).

Most dunes are found in large groups known as *dune fields.* Extremely large areas of dunes in the Sahara and other large deserts are called *sand seas.* Many dunes migrate across the land as the wind removes sand grains on one side of the dune and deposits them on the other side. Migrating dunes can block highways, bury houses, and destroy agricultural land.

Notable dune areas in the United States include Cape Cod in Massachusetts, Indiana Dunes State Park in Indiana, and Great Sand Dunes National Monument in Colorado. Other sites are White Sands National Monument in New Mexico and Death Valley National Park and the Imperial Valley, both of which are in California.

Wayne Lambert

See also **Desert; Sahara** (picture).

Dung beetle. See Scarab.

Dunham, *DUHN am,* **Katherine** (1910?-), an American dancer and *choreographer* (dance creator),

New York Public Library

Katherine Dunham became known for her choreography of black dances. Dunham, *shown here in the center,* danced with her company on Broadway in *A Tropical Revue* (1943).

became noted for her interpretations of the dances of blacks of the West Indies and the United States. She made extensive studies of dances of Jamaica. In the late 1930's and early 1940's, Dunham served as a dancer and choreographer in motion pictures and stage musicals. She organized her own dance company, touring the United States and Europe with ballets that were based on African and Caribbean ceremonial and folk dances. Dunham operated her own school of dance.

Dunham was born in Chicago on June 22, probably in 1909 or 1910. She studied anthropology at the University of Chicago. Dunham described her experiences in Jamaica in *Journey to Accompong* (1946). Her autobiography, *A Touch of Innocence,* was published in 1959.

Selma Landen Odom

Duniway, Abigail Jane Scott (1834-1915), was a leader of the campaign for women's voting rights in the Pacific Northwest. Her efforts helped achieve *suffrage* (voting rights) for women in Idaho in 1896, Washington in 1910, and Oregon in 1912.

Oregon Historical Society

Abigail Duniway

Abigail Jane Scott was born on Oct. 22, 1834, in Tazewell County, Illinois. Her family moved to Oregon when she was 17 years old. In 1853, she married Benjamin C. Duniway, a farmer. He was injured nine years later and became an invalid. For several years, she supported her husband and their six children by operating a women's hat shop in Albany, Oregon. During this time, she became increasingly aware of the unequal treatment of men and women by the law.

In 1871, Duniway moved her family to Portland, Oregon. For the next 16 years, she published *The New Northwest,* a weekly newspaper that demanded equal rights for women. In 1873, she helped found the Oregon State Woman Suffrage Association. Jesse L. Gilmore

Dunkerque, *DUHN kuhrk* (pop. 72,333; met. area pop. 191,173), is a French seaport and industrial center and the site of a dramatic Allied evacuation during World War II. Dunkerque—which is also spelled *Dunkirk* and *Dunquerque*—lies in northern France, where the English Channel meets the North Sea. For location, see **France** (political map).

Dunkerque has an excellent harbor and is one of the busiest ports in France. It is also a major center for petroleum refining and steel processing. Other industries include food processing, shipbuilding, and ship repair.

Dunkerque was founded by Saint Eloi in the A.D. 600's. By the 1500's, it had become a leading French port. In late May of 1940—during World War II—Germany won control of Belgium from the Allies. On May 26, thousands of British and French troops, and some Belgian troops, began retreating from Belgium to Dunkerque. Germany attacked the city, and it was badly damaged. But from late May until June 4, more than 800 vessels evacuated about 338,000 Allied troops from Dunkerque to England. The vessels included cruisers, destroyers, gunboats, minesweepers, fishing boats, motorboats, and yachts. The evacuation ranks as one of the best-planned military movements in history. It has been called the Miracle of Dunkerque. Mark Kesselman

Wide World

The escape from Dunkerque in 1940 became one of the most famous events of World War II. Allied ships and other vessels carried about 338,000 retreating troops to safety in England.

See also **World War II** (The invasion of the Low Countries).

Dunkers. See **Brethren, Church of the.**

Dunlap, William (1766-1839), has been called the father of American drama. He was the first professional playwright in America, the first to produce his own plays, and the first to champion the cause of the native dramatist. He was also the first to adapt plays from the French and German, and his *History of the American Theatre* (1832) is the earliest account of the American stage. Of the 56 plays attributed to him, 27 are originals and 29 translations or adaptations. Dunlap's best-known original plays include *André* (1798), *Leicester* (1806), and *A Trip to Niagara* (1828).

Dunlap also wrote biographies and a valuable source book, *History of the Rise and Progress of the Arts of Design in the United States* (1834). He was also a successful painter. Dunlap was born on Feb. 19, 1766, in Perth Amboy, New Jersey. Frederick C. Wilkins

Dunlop, John Boyd (1840-1921), a Scottish veterinarian, improved on the *pneumatic* (air-filled) *tire* that Robert W. Thomson had invented. Dunlop first made his tires to replace solid rubber ones on his son's tricycle. Dunlop's tire was tested and patented in Britain in 1888 and in the United States in 1890. It quickly became widely used on bicycles and automobiles. He was born on Feb. 5, 1840, in Dreghorn, Ayrshire. David F. Channell

Dunne, *duhn,* **Finley Peter** (1867-1936), was an American humorist and journalist. He created the character of Mr. Dooley, an Irish Roman Catholic owner of a tavern in Chicago. Dooley expressed Dunne's social and political views in over 700 newspaper sketches from 1893 to 1919. In a comic Irish dialect, Dooley criticized American foreign policy, social fads, politicians, overly enthusiastic reformers, and the follies he saw in labor and management. As a neighborhood philosopher and independent businessman, Dooley became a spokesman for conservative older Americans.

Dunne was born on July 10, 1867, in Chicago and had a personal background similar to that of Mr. Dooley. Dunne spent much of his adult life working as a newspaper and magazine editor. Sarah Blacher Cohen

Dunning, John Ray (1907-1975), an American physicist, did research work that was important in developing the atomic bomb. With the cooperation of Alfred O. Nier, who separated small quantities of the *isotopes* (forms) of uranium known as U-235 and U-238 from each other, Dunning, E. T. Booth, and A. V. Grosse proved that slowly moving neutrons can cause U-235—but not U-238—to *fission,* or split (see **Uranium** [Fissionability]). Dunning also proved that nuclear forces depend partly upon magnetic properties of the neutron.

Dunning pioneered in research on the discharge of neutrons from uranium fission. During World War II, he directed research in isotope separation which was put into large scale use at Oak Ridge, Tennessee.

Dunning was born on Sept. 24, 1907, in Shelby, Nebraska, and was graduated from Nebraska Wesleyan University. He received his Ph.D. degree at Columbia University. Dunning began teaching physics at Columbia University in 1933. He was Dean of the School of Engineering and Applied Science at Columbia from 1950 until 1969. Daniel J. Kevles

Duns Scotus, *duhnz SKOH tuhs,* **John** (1265 or 1266-1308), was one of the greatest theologians and philosophers of the Middle Ages. His ideas on God, knowledge, salvation, and the nature of being influenced many thinkers of the late Middle Ages.

According to tradition, Duns Scotus was born in Duns, Scotland, and entered the Franciscan religious order as a youth. His most important work was the *Opus Oxoniense* (*Oxford Work*). The book grew out of lectures Duns Scotus presented at Oxford University on *The Four Books of Sentences,* an influential medieval theological book by Peter Lombard. Duns Scotus also produced commentaries on Aristotle's ideas on logic and wrote *Quaestiones quodlibetales* (*Various Disputations*), which examines a variety of controversial philosophical and theological questions.

Duns Scotus also became known for his defense of the doctrine of the Immaculate Conception. According to this doctrine, the Virgin Mary was conceived free of original sin. His defense contributed to its recognition, centuries later, as an official doctrine of the Roman Catholic Church. William J. Courtenay

See also **Scholasticism** (History).

Dunsany, Lord (1878-1957), was an Irish author who is remembered today for his fantastic tales. He is also known for such plays as *The Glittering Gate* (1909), *The Gods of the Mountain* (1911), *A Night at an Inn* (1916), and *If* (1921).

Lord Dunsany was born Edward John Moreton Drax Plunkett in London of Irish parents on July 24, 1878. He was a noted sportsman and soldier. Dunsany's writing is filled with the exotic wonder of fairy tales. His best literary work is found in his short pieces, and all his writings tend toward the form of the ironic fable. Many of his writings deal with the supernatural, and he invented his own mythology—"heavens and earths, and kings and peoples and customs, just as I need them." Nevertheless, his works show the influence of Oriental, Biblical, and classical literature. He wrote an autobiography, *Patches of Sunlight* (1938). Edward Hirsch

Dunstan, *DUHN stuhn,* **Saint** (909?–988), was an English religious reformer, statesman, and archbishop of Canterbury. He acted as an adviser to a number of kings of Wessex—a kingdom in southern England—including Kings Edmund, Edred, and Edgar. Dunstan also helped revive English monasteries by rebuilding them and by strengthening discipline among their residents. Many monasteries had been destroyed by the Danes, who had invaded England during the 800's. Dunstan also worked to unify England by helping make peace with Danes who lived in northern England.

Dunstan was born near Glastonbury into an aristocratic family. His uncle was the archbishop of Canterbury. About 943, King Edmund made him abbot of a monastery at Glastonbury. In 956, Dunstan was banished from Wessex by King Edwig, whose conduct Dunstan had criticized. But Dunstan returned to Wessex after Edgar gained power there. Edgar made Dunstan bishop of London in 958 and archbishop of Canterbury in 959. Dunstan's feast day is May 19. William J. Courtenay

Duodecimal system, *doo uh DEHS uh muhl,* is a way of grouping numbers based on 12 instead of 10, as in the commonly used decimal system. The word *duodecimal* comes from the Latin words for *two* and *ten.* The system uses 12 symbols, which are 0 through 9, T, and E. T, E, and 10 stand for the decimal system's 10, 11, and 12. For example, 1T stands for 22 (12 + 10). Merchants use a duodecimal system when they count by the dozen or *gross* (12 dozen or 144). Early people may have chosen 12 as a unit of measure, such as 12 inches to a foot, because it can be evenly divided by more numbers than 10 can. Joseph W. Dauben

See also **Numeration systems.**

Duodenum. See **Stomach.**

Dupin, Amantine Lucile. See **Sand, George.**

Duplicate bridge. See **Bridge** (Duplicate bridge).

Duplicator is any of several machines that reproduce typed, printed, or handwritten matter using a special form called a *master.* Some schools, churches, and businesses use duplicators to produce many copies of an item inexpensively.

Other devices, called *copying machines,* produce copies without a master. In most businesses, *electrostatic copying machines* have replaced duplicators. These machines are cheaper for smaller copying jobs and are easier to use. See **Copying machine.**

There are three main types of duplicators. They are (1) *spirit duplicators,* (2) *stencil duplicators,* and (3) *offset duplicators.*

Spirit duplicators use a master made from a sheet of paper backed by another sheet that contains a waxy, dye-filled substance. The user types, writes, or draws on the front of the plain sheet the material to be copied. The pressure of this operation transfers some of the dye-filled substance to the back of the master. Next, the user removes the back sheet and places the master face-down on a drum in the duplicator machine. As the drum turns, the machine moistens a sheet of blank paper in an alcohol-based solution. The machine then presses the sheet against the master. The solution dissolves some of the dye and transfers it to the blank sheet, thus creating a copy.

A master for a spirit duplicator can make about 300

copies. The spirit duplicator got its name from the alcohol in the solution.

Stencil duplicators use a strong, plastic-coated master with cuttings. The most popular stencil duplicator is the *mimeograph.* Usually, the user makes the master by typing on the coated sheet. The user then places the stencil on an ink-filled cylinder. As the cylinder turns, the machine presses blank paper against the stencil. The pressure pushes ink through the cuttings onto the paper, creating a copy. A master for a stencil duplicator can make thousands of copies.

Manufacturers introduced the digital stencil duplicator in the late 1980's. Unlike others, this duplicator creates the stencil. Components inside the machine scan material to be copied and translate it into a *digital* (numerical) code. The machine then uses the code to burn the appropriate cuttings into the paper master. The machine makes the copies and then discards the stencil.

Offset duplicators are more complex machines that work in the same way as offset printing presses. However, most offset duplicators are built to print fewer copies and use only one color of ink.

An offset duplicator uses a metal or paper printing plate as its master. The operator fastens the master to a cylinder in the duplicator. The machine inks the master. Next, the master *offsets* (transfers) the image to another cylinder, which then offsets the image to a blank sheet of paper. See **Offset; Printing** (Offset lithography).

Eileen Feretic

Du Pont, Éleuthère Irénée, *eh luh TYAYR ee ray NAY* (1771-1834), founded a gunpowder company in 1802 that was the forerunner of the present-day DuPont Company. Throughout the 1800's, the firm was known as the premier gunpowder and explosives manufacturer in the United States.

Du Pont was born on June 24, 1771, in Paris. His father was Pierre Samuel du Pont de Nemours, a well-known French economist. In 1799, Irénée emigrated to the United States. While on a hunting trip, he recognized the need for low-cost, quality gunpowder in his adopted country. Du Pont erected his gunpowder works near Wilmington, Delaware. The firm's sales increased steadily between 1804 and 1811. The sharp rise in demand accompanying the War of 1812 helped guarantee the company's success. John A. Heitmann

DuPont Company, officially E. I. du Pont de Nemours and Company, is one of the world's largest manufacturers and marketers of chemicals and chemical products. The company has about 125 plants in the United States and affiliates in Canada and other countries. These plants make industrial films, automotive and industrial paints, plastics, electronic products, health-care products, agricultural chemicals, and many kinds of basic chemicals. Other DuPont products include such synthetic textile fibers as nylon, polyester, and acrylic. The company's headquarters are in Wilmington, Delaware.

Éleuthère Irénée du Pont, a student of the famous French chemist Antoine Lavoisier, founded the company in 1802. At first the company made only gunpowder, but in 1880 it began producing high explosives. In 1890, DuPont started producing a smokeless explosive based on nitrocellulose. It then became interested in the many useful applications of cellulose (see **Cellulose**). The company began manufacturing lacquers, adhesives, finishes, and plastics. Since the early 1900's, DuPont has rapidly enlarged its list of products. Today, the company manufactures about 40,000 different products.

During World War II (1939-1945), DuPont designed, built, and operated a $350-million center at Hanford, near Richland, Washington, for the manufacture of plutonium (see **Plutonium**). In 1950, DuPont agreed to design, build, and operate the Savannah River plant in South Carolina for the Atomic Energy Commission. Other developments since the war include Orlon acrylic fiber, Dacron polyester fiber, Kevlar aramid fiber, and Lycra spandex fiber.

Critically reviewed by the DuPont Company

See also **Du Pont, Éleuthère Irénée; Manufacturing** (table).

Du Pont de Nemours, Pierre Samuel *doo PAHNT duh nuh MUR,* (1739-1817), was a French economist and statesman. His son, Éleuthère Irénée du Pont, founded what is now the DuPont Company.

Du Pont was born on Dec. 14, 1739, in Paris. He first studied medicine but then turned to economics. He became famous as a member of a group of economists known as the *physiocrats,* who believed governments should interfere less in economic life. The physiocrats also began the first organized study of how economies work. Du Pont wrote extensively on physiocratic doctrines and had a major impact on French economic policies at the time. Du Pont got caught in political conflicts during the French Revolution (1789-1799). He fled with his family to the United States in 1799. Barry W. Poulson

Duralumin, *du RAL yuh muhn,* is a term for any one of a group of aluminum-copper alloys. A typical duralumin alloy is made up of about 95 percent aluminum, 4 percent copper, 0.5 percent magnesium, and 0.5 percent manganese. Some duralumin alloys also include a small amount of silicon or iron. Duralumin is strong and light and is used in making aircraft parts and heavy-duty equipment. The term is obsolete in the United States but is used in other countries. Melvin Bernstein

Durant, *duh RANT,* Will (1885-1981), was an American historian, philosopher, and educator. He first won recognition in 1926 for his *The Story of Philosophy.* He began his major historical series, *The Story of Civilization,* in 1935. Volumes in this series consist of *Our Oriental Heritage, The Life of Greece, Caesar and Christ, The Age of Faith, The Renaissance, The Reformation, The Age of Reason Begins, The Age of Louis XIV, The Age of Voltaire, Rousseau and Revolution,* and *The Age of Napoleon.* His wife, Ariel, was coauthor of the last five volumes in the series. Durant described the artistic, intellectual, and spiritual developments of each period.

William James Durant was born on Nov. 5, 1885, in North Adams, Massachusetts. His other works written with his wife include *The Lessons of History* (1968), *Interpretations of Life* (1970), and *A Dual Autobiography* (1977). Edwin H. Cady

Durant, William Crapo (1861-1947), was an American automobile manufacturer and the founder of General Motors. He developed the idea that success in the auto industry lay in bringing together a combination of car manufacturers who offered a variety of models.

Durant was born on Dec. 8, 1861, in Boston. In 1886, he became a carriagemaker in Flint, Michigan. In 1904, he bought the Buick Motor Car Company. His skill as an

administrator and promoter helped him make Buick the largest automobile manufacturer in the United States. Durant organized the General Motors Company in 1908, and the company grew rapidly. It soon included the firms that made Buick, Cadillac, Oakland, Oldsmobile, and eight other makes of cars. But Durant had overexpanded, and he was forced to give up control in 1910. In 1911, he created the Chevrolet Motor Car Company. Its success enabled Durant to regain control of General Motors in 1916, and the company was incorporated as General Motors Corporation. He was forced out again in 1920 because of another financial crisis. In 1921, he formed another company, Durant Motors, which went bankrupt in 1933. Joel Webb Eastman

Durante, *duh RAN tee,* **Jimmy** (1893-1980), was an American entertainer. He began his career playing the piano. His comic singing and clowning won him fame in vaudeville, the theater, nightclubs, movies, radio, and television. Durante made his large nose the object of many jokes and became known as the *Schnozzola.* In 1951, he received a Peabody Award for television entertainment. The entertainer's biography, *Schnozzola: The Story of Jimmy Durante,* was written by Gene Fowler. James Francis Durante was born on Feb. 10, 1893, in New York City. Gerald Bordman

Durban, *DUR buhn* (pop. 715,669; met. area pop. 1,106,971), is the chief eastern seaport in South Africa. It is the largest city of the province of KwaZulu-Natal. For location, see **South Africa** (political map). Durban is a trading and industrial center and the most important resort city of South Africa. It is the most English of South Africa's cities in both language and culture. But South Asians outnumber whites. Most Africans in Durban are Zulus. Durban was founded in 1834. Bruce Fetter

Dürer, *DYUR uhr,* **Albrecht** (1471-1528), was the most famous painter and printmaker in the history of German art. He also became famous as a scholar and author. Dürer was the first writer to describe the concept of artistic genius and the first to publish scientific literature in German.

Dürer's published works include books on geometry and perspective, civil defense, and the measurements of the human body. In his studies on artistic theory, Dürer tried to explain idealized beauty as well as ugliness, and differences in human personality and appearance.

Dürer was born on May 21, 1471, in Nuremberg. Between the ages of 13 and 40, he painted and drew a remarkable series of revealing self-portraits. He also wrote a travel diary and many letters and completed a family history. These self-portraits and writings have helped historians learn more about Dürer as a person than about any other northern European artist of his day.

Detail of a self-portrait (1493), an oil painting on wood panel; The Prado, Madrid

Albrecht Dürer

Dürer's most famous oil paintings include *Self-Portrait* (1500), which appears in the **Painting** article; an altarpiece for the Church of the Germans in Venice, called *The Feast of the Rose Garlands* (1506); and *Four Apostles* (1526), which was painted for the Nuremberg city hall. One of his most popular pictures is a brush drawing called *Praying Hands* (1508), which was a study for part of an altarpiece for a church in Frankfurt (am Main).

Paumgartner Altarpiece; Pinakothek, Munich, Germany (SCALA/Art Resource)

Dürer's *The Nativity* shows the influence of Italian Renaissance painting in its use of perspective and proportion. The picture is the central panel of an altarpiece completed in 1503.

Dürer was the first major artist to paint realistic water colors from nature. The best known of his nature studies include several landscapes painted in the Austrian and Italian Alps and scenes from the Nuremberg area. As a printmaker, Dürer created many woodcuts, most dealing with religious subjects. Some of his engravings portray traditional Christian subjects. Other engravings picture Greek and Roman myths and allegories. In these prints, Dürer introduced idealized nude figures into German art. Dürer was also one of the first printmakers to experiment with etching. Jane Campbell Hutchison

For examples of Dürer's work, see **Bookplate; Four Horsemen of the Apocalypse; Horse** (Horses in history); **Painting** (The northern Renaissance); **Witchcraft.**

Durham, *DUR uhm* (pop. 85,000), is a fortress town in northern England. It stands on a hill that is almost completely surrounded by the River Wear (see **England** [political map]). Durham Cathedral, which was begun in 1093, is a fine example of Norman architecture. Many tourists visit Durham to see the cathedral, as well as a Norman castle that houses part of the University of Durham. M. Trevor Wild

Durham, *DUR uhm,* North Carolina, (pop. 187,035), is a city in the north-central part of the state. With Raleigh and Chapel Hill, it forms a metropolitan area of 1,187,941 people (see **North Carolina** [political map]). Durham is a

regional center for education, health care, and industry. Its chief products are cigarettes, hosiery, lumber products, machinery, pharmaceuticals, and textiles. Duke University, Duke Medical Center, Durham Technical Community College, and North Carolina Central University are in the city. Research Triangle Park is a large research complex in the area.

The area was settled in the 1750's. But the city didn't develop until the mid-1800's, when a railroad was built through what was then the small village of Durhamville. Tobacco crops flourished in the soil of the area. Durham produced an early smoking tobacco known as Bull Durham. In 1865, General Joseph E. Johnston surrendered his Confederate Army to Union General William T. Sherman at the Bennett Place, just west of the city.

Durham was incorporated in 1869. The city has a council-manager form of government. It is the seat of Durham County. Jerry L. Surratt

Durham, *DUR uhm,* **Earl of** (1792-1840), was a British political leader and governor general of the United Kingdom's Canadian colonies. A government report that he wrote about Canada in 1839 has long been considered an important document in Canadian history. But a number of scholars have shown that the report had little effect on British policies toward the Canadian colonies.

Durham served as governor general of Canada for about four months. He went there in 1838 to investigate the causes of rebellions in the colonies of Upper Canada and Lower Canada (see **Rebellions of 1837**). Durham resigned when the British Parliament disagreed with his mild punishment of the rebels.

After returning to the United Kingdom, Durham wrote his *Report on the Affairs of British North America.* The report urged the government to unify Upper and Lower Canada and to give the Canadian colonies self-government in local affairs. These proposals were later adopted. But they originally had been suggested by other people, and Durham's report was largely disregarded by the British Parliament.

Durham was born April 12, 1792, in London. His full name was John George Lambton. He was elected to Parliament in 1813. Durham became a Cabinet member in 1830 and helped write the Reform Act of 1832. The reform act gave most men of the middle class the right to vote. Durham served as a diplomat in Russia in 1832 and from 1835 to 1837. Lambton became Earl of Durham in 1833. J. M. Bumsted

Durkheim, *DURK hym,* **Émile,** *ay MEEL* (1858-1917), was a French sociologist. His theories and writings helped establish the foundations of modern sociology. Durkheim disagreed with most social theorists of the late 1800's because they thought that individual psychology was the basis of sociology. Durkheim regarded sociology as the study of the society that surrounds and influences the individual. Durkheim explained his theories in his book *The Rules of Sociological Method* (1895).

In *The Division of Labor* (1893), Durkheim developed the theory that societies are bound together by two sources of unity. He called these sources *mechanical solidarity* and *organic solidarity.* Mechanical solidarity refers to similarities that many people in the society share, such as values and religious beliefs. Organic solidarity results from the division of labor into specialized jobs. Durkheim believed that the division of labor makes people depend on one another and thus helps create unity in a society.

Durkheim studied thousands of cases of suicide to demonstrate his theory that a person commits suicide because of the influence of society. He explained this theory in *Suicide* (1897).

Durkheim was born on April 13, 1858, in Épinal, France. He studied at the École Normale Supérieure in Paris and taught sociology at the University of Bordeaux and at the Sorbonne in Paris. Neil J. Smelser

See also **Mythology** (Mythology and society).

Durrell, *DOOR uhl,* **Gerald** (1925-1995), was an English naturalist and author. He was best known for his work in wildlife preservation and his books on animals. Durrell described his experiences with animals in lighthearted stories. Many are popular with young readers.

Durrell was born on Jan. 7, 1925, in Jamshedpur, India, of British parents. He was educated in Europe by private tutors. In 1947, Durrell began a career of leading zoological expeditions. He traveled to Cameroon, Madagascar, Mexico, Australia, and other places to collect animals for zoos in Europe and North America. Durrell began writing to help finance his expeditions. His first book was *The Overloaded Ark* (1953).

In the mid-1950's, Durrell decided to create his own zoo. He opened his zoo in Jersey, England, in 1959, and dedicated it to breeding endangered species. This zoo is known as the Jersey Zoological Park, and it is now operated by the Jersey Wildlife Preservation Trust. Durrell wrote more than 30 books, including *A Zoo in My Luggage* (1960) and *The Stationary Ark* (1976). He also wrote *The Amateur Naturalist* (1983) with his wife, Lee. Deborah A. Behler

Durrell, *DOOR uhl,* **Lawrence** (1912-1990), was an English novelist, travel writer, and poet. He became best known for his series of four novels called *The Alexandria Quartet.* The *Quartet* consists of *Justine* (1957), *Balthazar* (1958), *Mountolive* (1959), and *Clea* (1960). The novels are noted for their ornate language, unusual characters, and vivid descriptions of the Mediterranean Sea and the city of Alexandria, Egypt, during the late 1930's. Durrell described a series of love affairs as viewed by the leading characters with different perspectives on what makes up the truth of their experience. Durrell championed all forms of love in the *Quartet,* but saw its expressions as leading to tragedy and despair.

Lawrence George Durrell was born on Feb. 27, 1912, in Darjeeling, India. He lived most of his life in the eastern Mediterranean. His first novel, *The Black Book* (1938), reveals the influence of his friend, the American novelist Henry Miller. Durrell described life on the islands in and near Greece in *Prospero's Cell* (1945), *Reflections on a Marine Venus* (1953), *Bitter Lemons* (1957), and *The Greek Islands* (1978). He narrated a tour through Sicily in *Sicilian Carousel* (1977). Durrell's poetry appears in *Collected Poems, 1931-1974* (1980). Michael Seidel

Dürrenmatt, *DOO ruhn maht,* **Friedrich,** *FREE drihsh* (1921-1990), was a Swiss dramatist and novelist. Many of his plays are tragicomedies notable for their odd and arresting effects. His work shows a fascination with strange and paradoxical situations and characters. Dürrenmatt presented the world of his time in a state of decay and corruption. But some of his characters speak for his conviction that courage and goodness are possi-

ble. In his best-known play, *The Visit* (1956), the main character eventually atones for his own guilt, though he is surrounded by moral decay. Dürrenmatt also wrote *Romulus the Great* (1949), *The Marriage of Mr. Mississippi* (1952), *The Physicists* (1962), and *Play Strindberg* (1969). His fiction includes *Traps* (1956) and *The Pledge* (1958). Dürrenmatt was born near Bern. Siegfried Mews

Duryea brothers, *DUR yay* or *DUR ee ay,* were two automobile pioneers. Charles E. Duryea (1861-1938) and J. Frank Duryea (1869-1967) built the first successful gasoline-powered car in America. Their one-cylinder model made a trial run in 1893 in Springfield, Massachusetts. The brothers formed the Duryea Motor Wagon Company in Springfield in 1895, and produced 13 cars in 1896.

In 1898, Frank Duryea joined the Stevens Arms Company. There, he designed the four- and six-cylinder Stevens-Duryea automobiles. Charles was born in Canton, Illinois, and Frank in Washburn, Illinois.

William L. Bailey

Du Sable, *doo SAH bluh,* **Jean Baptiste Point,** *zhahn bah TEEST pwahnt* (1745-1818), a black American pioneer, was the first known settler to build a house and open a trading post in what became Chicago. His name is also spelled Sable, De Sable, and De Saible.

Du Sable was probably born in Haiti. He came to the Chicago area during the 1770's. He made friends with the Indians, and married a Potawatomi Indian. He had a farm near Peoria in 1773. Du Sable built a log cabin on the north bank of the Chicago River about 1779. He operated his trading post in part of the cabin, and became rich trading with the Indians.

Edgar Allan Toppin

See also **Chicago** (History).

Detail of an aquatint by an unknown artist. Courtesy of Chicago Historical Society

Jean du Sable

Duse, *DOO zay,* **Eleonora,** *eh leh aw NAW rah* (1858-1924), an Italian actress, has been called the greatest actress of her time. Duse seemed to live her parts instead of act them. Critics praised her natural and sincere acting.

Gabriele D'Annunzio wrote some of his best plays for her, including *La Gioconda* and *Francesca da Rimini* (see **D'Annunzio, Gabriele**). He fell in love with her and wrote a book, *The Flame of Life* (1900), based on their love story. Duse acted in Alexandre Dumas *fils' Camille* and in Henrik Ibsen's dramas *A Doll's House, Hedda Gabler,* and *The Lady from the Sea.* Her performances in these works established her reputation. Duse also acted in Giovanni Verga's tragedy *Cavalleria Rusticana.*

Duse was born in Vigevano. She made her first public appearance at the age of 4. At 14, she played Juliet in *Romeo and Juliet.* J. P. Wearing

Dushanbe, *doo SHAHN buh* (pop. 595,000), is the capital and largest city of Tajikistan. It lies in a cotton-growing valley at the foot of the Gissar Range of the Tian Shan mountains (see **Tajikistan** [map]). Dushanbe is Tajikistan's scientific, cultural, and educational center. Much of the region's industry is centered there. Dushanbe's products include silk, textiles, processed foods, and machinery. Nearby hydroelectric stations supply power to the city and to metals and chemical plants in the area.

Dushanbe was established in 1926 by the merger of three small villages. After Tajikistan became a republic of the Soviet Union in 1929, the Soviet government changed the city's name to Stalinabad in honor of the Soviet dictator Joseph Stalin. During the "destalinization" campaign of 1961, the name was changed back to Dushanbe. The Soviet Union was dissolved in 1991, and Tajikistan became independent. Leslie Dienes

Düsseldorf, *DOOS uhl dawrf* (pop. 575,594), is a commercial and industrial city in Germany. It lies on the Rhine River (see **Germany** [political map]).

Düsseldorf has many beautiful buildings, parks, and gardens, and fashionable shops. Landmarks include St. Lambertus Church, a Gothic structure built in the 1200's; and the town hall, which dates from the late 1500's. Düsseldorf is the home of a well-known art academy and a medical school. The city has a large harbor that is a base for important container shipping industries. Other industry includes banking, commerce, and the manufacture of chemicals, iron, and steel.

Düsseldorf was chartered as a city in 1288, though settlements existed on the city's present site as early as the 700's. Allied bombing raids during World War II (1939-1945) badly damaged many sections of the city. But the damaged areas were soon rebuilt. John W. Boyer

Dust consists of dry, solid particles less than 0.0625 millimeter ($\frac{1}{400}$ inch) in diameter—smaller than the tiniest grains of sand. Most dust is mineral material that comes from bare soil, plowed fields, river flood plains, and floors of desert basins. Dust also comes from ocean spray, meteoroid fragments, smoke and ash produced by fires, volcanic eruptions, and decaying organic materials. The wind easily lifts dust particles and often carries them for long distances. Winds in the stratosphere can carry fine volcanic dust around the world several times.

Dust deposits. The wind picks up and deposits fine particles of dust repeatedly. The coarsest grains, however, tend to settle rapidly to the surface and remain there. Dust washed into streams may reach the oceans and gather as mud.

Thick deposits of coarse dust called *loess* have formed on the land in central Asia and east-central China, central and eastern Europe, central and northwestern United States, and Argentina. Deposits in China reach a thickness of 1,300 feet (400 meters). One major source of loess is the floodplains of meltwater streams that drained the major ice sheets during the glacial ages. Desert basins are another major source of loess.

Influence on climate. Dust particles take part in the formation of clouds. Dust particles in the atmosphere attract water vapor, forming water droplets. The droplets then gather to make clouds.

Volcanic dust in the atmosphere scatters sunlight, reflecting some of it back into space. When the atmosphere contains much volcanic dust, this scattering can lower temperatures at the earth's surface.

Influence on human health. Large amounts of dust are in the air at many quarries, mines, and factories. Workers who breathe in much of the dust can develop such lung diseases as *black lung, brown lung,* and *sili-*

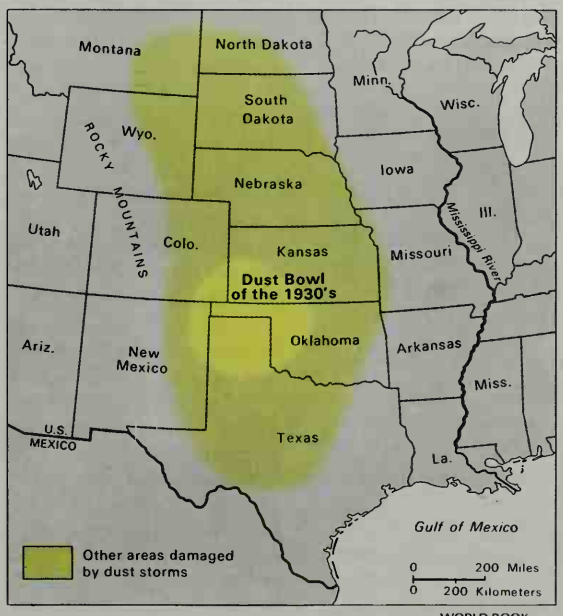
cosis (see **Black lung; Brown lung; Silicosis**). Dust can also carry bacteria that cause diseases. The spore stages of some disease bacteria can be thought of as dust particles. Organic materials that are in house dust may also cause allergies. Stephen C. Porter

See also **Dust Bowl; Dust storm; Air** (Particles in the air); **Air cleaner.**

Dust Bowl refers to a series of destructive wind and dust storms that struck the United States during the 1930's. These storms ranked among the worst environmental disasters in world history. Most of the damage occurred from 1935 to 1938 in the southern Great Plains, and so this area also became known as the Dust Bowl. Altogether, the storms damaged about 50 million acres (20 million hectares) of land, mainly in Colorado, Kansas, New Mexico, Oklahoma, and Texas. An additional 50 million acres were endangered before conservation measures began to take effect.

The soil of the Dust Bowl had become dry and loose by the early 1930's. This occurred partly because much of the area's natural grassland was converted to wheatland during the early 1900's. But the wheat, as it was grown then, did not adequately protect the ground against winds. In addition, the remaining grasslands were destroyed through the grazing of too much livestock. Furthermore, a drought that lasted seven years began in 1931. Thus, the soil was easily eroded and blown when strong winds whipped through the region.

Dust storms had struck the Great Plains before, but they were never as large and destructive as those of the 1930's. One of the first major storms struck in May 1934. It carried approximately 350 million tons (318 million metric tons) of dirt all the way to the East Coast. About 40 big storms swept through the Dust Bowl in 1935, with dust often reducing visibility to less than 1 mile (1.6 kilometers).



WORLD BOOK map

The Dust Bowl, an area of the Great Plains, was formed by severe dust storms of the 1930's. Dust storms swept across other parts of the Great Plains during the 1950's, 1960's, and 1970's.

AP/Wide World

Dust storms of the 1930's, such as the one above, blew the powdery topsoil away in great clouds. The droughts that contributed to the dust storms damaged crops in most of the Southwest and Great Plains, causing great hardship.

Most of the storms came in the spring. At that time, the snow had melted, the winds were unusually strong, and the new crops were not big enough to hold the soil. Many people and animals caught in the open during the storms had their lungs badly damaged or became lost. Dirt had to be shoveled out of houses and away from barn doors. Cars and farm machines were ruined. The region's agricultural economy was wrecked as farmers could find little to harvest. One of the most dramatic results was the mass departure of thousands of bankrupt and discouraged farm families, many of whom went to California to seek a better life. *The Grapes of Wrath* (1939) by John Steinbeck describes the unhappy plight many of these migrants faced.

The federal government sent aid to the Dust Bowl. The Soil Conservation Service, which was set up in 1935, taught farmers ways to slow erosion and protect the soil. In addition, more than 18,500 miles (29,800 kilometers) of trees were planted in small belts to break the force of the winds. As the crisis passed, however, many farmers abandoned the protective farming methods. During droughts in the 1950's and the 1970's, dust storms again damaged the Dust Bowl region.

Donald Worster

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Dust devil is a whirling column of air. It is caused by the rising of an overheated layer of air near the ground. Dust devils occur most frequently in deserts, where the sun heats the air near the dry ground to a high temperature. The motion of the air as it rises can often be seen because it may carry sand and dust 1,000 feet (300 meters) or more above the earth. Margaret A. LeMone

Dust mite is a tiny animal related to ticks and spiders that lives in people's homes. Dust mites, known officially as *house dust mites*, are less than $\frac{2}{100}$ inch (0.5 millimeter) long. They thrive in places that are relatively moist and warm, such as bedding, carpets, and upholstered furniture. Their chief food is dandruff and other skin flakes, which make up much of the "dust" that accumulates in houses. Mattresses provide an ideal environment for dust mites, because sleeping bodies shed skin and produce moisture and warmth all through the night. Researchers have counted more than 40,000 dust mites in 1 ounce (28 grams) of mattress dust.

Dust mites are medically important because their bodies and waste products are among the world's most widespread *allergens*. An allergen is a substance that causes an allergic reaction in people who are sensitive to it. Some studies show that as many as 10 to 15 percent of people react to dust mites. Inhaling dust mite allergens can trigger *asthma*, a condition that narrows the air passages in the lungs and hampers breathing. Skin contact with dust mite particles can also cause *eczema*, an allergic reaction that makes skin red, irritated, and itchy.

Eliminating dust mites is difficult, but certain measures help limit their numbers. Experts recommend that allergic people put protective covers on their mattresses and pillows and avoid carpeting their bedrooms. Periodically applying certain chemicals may help control mites in other carpets. Vacuuming carpets and upholstered furniture weekly may also help, as does washing bedding regularly in hot water. May R. Berenbaum

Scientific classification. Dust mites belong to the genus *Dermatophagoides*.

© Oliver Meckes, Photo Researchers

A dust mite, shown here magnified 500 times, is a tiny animal commonly found in homes. Many people throughout the world are allergic to dust mites and their waste products.

Dust storm is a strong, turbulent wind that carries fine particles of clay, silt, and other earthy material for long distances. The particles are swept up and remain suspended in the air during a dust storm. Most of the particles measure less than 0.0625 millimeter ($\frac{1}{400}$ inch) in diameter. Dust storms occur where the ground has little or no protective vegetation because of low rainfall, grazing, or poor farming practices. Dust storms play an important role in soil erosion.

A dust storm may cover hundreds of miles and rise to a height of more than 10,000 feet (305 meters). It carries as much as 4,000 tons of dust particles per cubic mile of air (875 metric tons per cubic kilometer). Winds of at least 25 miles per hour (40 kilometers per hour) are associated with dust storms.

In the United States, a dust storm is reported when blowing dust reduces visibility below $\frac{5}{8}$ mile (1 kilometer). During the 1930's, parts of Colorado, Kansas, New Mexico, Oklahoma, and Texas were hit by dust storms that resulted from soil erosion. Today, dust storms occur in parts of northern Africa, Asia, and Europe.

Richard A. Dirks

See also **Dust Bowl; Shelterbelt.**

Dutch. See Netherlands.

Dutch Antilles. See Netherlands Antilles.

Dutch East India Company was a powerful trading company that helped establish Dutch rule in what is now Indonesia. In 1602, the Dutch government granted the company a monopoly on trade between Asia and the Netherlands. The company also received broad governmental and military powers, including the right to rule territories and to wage war in Asia.

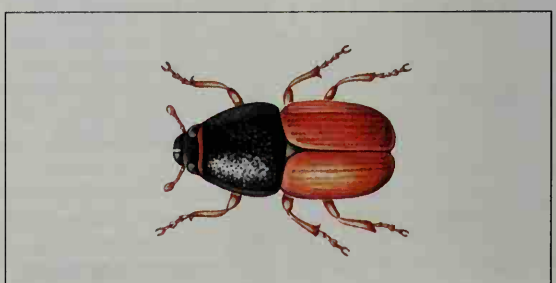
By 1700, the Dutch East India Company had gained control of the cinnamon, clove, and nutmeg trade in the East Indies. The company had trading posts in many Asian countries and ruled parts of what are now South Africa and Sri Lanka and most of present-day Indonesia.

In the 1700's, the demand for textiles from India, tea from China, and coffee from Arabia and Java exceeded that for spices. The Dutch East India Company had strong competition from the English East India Company and other traders. The Dutch company lost money and was disbanded in 1799. John E. Wills, Jr.

See also **East India Company; Flag** (picture: Flags in United States history); **Indonesia** (History); **Netherlands** (History); **South Africa** (History).

Dutch elm disease is a severe disease of the elm tree. It is caused by a fungus carried by the native elm bark beetle and the smaller European bark beetle. It can cause the death of a large elm in four to eight weeks.

Dutch elm disease usually begins with a wilting of the younger leaves in the upper part of the tree. Later, lower branches become infected. By midsummer, many of the



WORLD BOOK illustration by Oxford Illustrators Limited

The European bark beetle is one of the two kinds of beetles that spread Dutch elm fungus disease from tree to tree.

leaves turn yellow and then brown, and they curl and drop off. Some of the leaves remain attached to twigs. When diseased branches are cut, long brown streaks can be seen beneath the bark.

The best way to control Dutch elm disease is to plant disease-resistant elms. But few varieties of elms are immune to all strains of the fungus. The use of insecticides that control the beetles helps limit the spread of the disease. Spraying the trees with fungicides is not very effective. Many cities and towns have ordinances that require the removal of diseased trees.

Dutch elm disease is so called because the Dutch first observed it in the Netherlands in 1919. It became known in the United States in 1930 and was limited to an area close to New York City. The disease now afflicts elm trees throughout the nation. Jerry T. Walker

Dutch Guiana. See Suriname.

Dutch language. See Netherlands (People).

Dutch oven is a covered metal cooking pot. Modern Dutch ovens are usually made of aluminum. American pioneers used a cast-iron Dutch oven with a rimmed lid. The pot was set on hot coals, and coals were also placed on the lid. Brick ovens in fireplaces and chimneys are sometimes called Dutch ovens.

Dutch West India Company was formed by Dutch merchants and chartered by the government of the Netherlands in 1621. The company was given trading and colonizing privileges for a period of 24 years in the Americas and West Africa. The charter was renewed in 1647 for a period of 25 years. The Dutch West India Company founded the colony of New Netherland, which included parts of what are now the U.S. states of New York, New Jersey, Delaware, and Connecticut. See New Netherland; Patroon system. Richard W. Unger

Dutch West Indies. See Netherlands Antilles.

Dutchman's-breeches, also called *white heart,* is a small, delicate plant with flattened, heart-shaped flowers. It grows in woodlands from Nova Scotia to Georgia and west to Nebraska. It is also found in Washington and Oregon. The plant has lacy, fernlike leaves. Its stems are brittle and contain a watery sap. The stem grows from an underground tuber (see Tuber).

WORLD BOOK illustration by Robert Hynes

Dutchman's-breeches

Dutchman's-breeches gets its name from the shape of its flowers. Each leafless flower stalk has 4 to 10 nodding fragrant flowers that look like baggy trousers hanging upside down. The flowers are waxy white or pinkish-white with yellow tips. J. Massey

Scientific classification. Dutchman's-breeches is a member of the fumitory family, Fumariaceae. It is *Dicentra cucullaria.*

Duty, in economics. See Customs; Tariff.

Duvalier, *doo vahl YAY,* François, *frahn SWA* (1907-1971), was the president of Haiti from 1957 until his death in 1971. Duvalier ruled as a dictator and allowed no one to oppose him. He was elected to a seven-year term as president in 1957. In 1961, before his term ended, he declared himself reelected. He was elected president for life in 1964 by the National Assembly, whose members he had selected.

Duvalier was a physician and an authority on voodoo, a kind of religion practiced in Haiti. He used the Haitian peasants' fear of voodoo to maintain his power (see Voodoo). Many peasants believed he had magical powers. Duvalier also controlled the armed forces and a feared secret police force that the people call the *Tontons Macoutes* (bogeymen).

Duvalier was born in Port-au-Prince, Haiti. He graduated from the National University of Haiti medical school in 1934. He was secretary of labor and public health in 1949 and 1950, and adviser to a public health commission from 1952 to 1954. After François Duvalier died, his son—Jean-Claude Duvalier—became president. Jean-Claude also ruled as a dictator. Rebels overthrew his government in 1986, and he fled from Haiti. See Haiti (History). Thomas G. Mathews

Duvoisin, *dyoo vwah ZAN,* Roger Antoine (1904-1980), was a children's artist and illustrator. He won the 1948 Caldecott Medal for his illustrations for *White Snow, Bright Snow,* written by Alvin Tresselt. Duvoisin wrote and illustrated several popular children's books, including the *Petunia* and *Veronica* series. He also illustrated the *Happy Lion* series written by his wife, Louise Fatio.

Duvoisin was born in Geneva, Switzerland, and moved to the United States in 1927. He became a U.S. citizen in 1938. He wrote and illustrated his first children's book, *A Little Boy Was Drawing,* for his son in 1932. Jill P. May

DVD is a round, flat platter on which motion pictures, computer programs, or other information is stored in the form of *digital* (numeric) code. A DVD is the same size as a standard compact disc (CD)—about 4 $\frac{3}{4}$ inches (12 centimeters) in diameter—but it can store much more information than a CD can. Each side of a DVD can contain two data layers, one beneath the other. A single DVD can store up to 17 *gigabytes* (billion bytes) of information. *DVD* is often said to stand for Digital Versatile Disc or Digital VideoDisc. However, many people involved in the production of DVD's insist the letters have no specific meaning.

There are several types of DVD's. *DVD-Video* (often simply called DVD) stores materials that combine visuals and sound, such as motion pictures and concert performances. The discs are played using a DVD-Video player connected to a television set. *DVD-Audio* stores six channels of sound and can be played on a DVD-Audio player. A *universal* player can play DVD-Video, DVD-Audio, and audio CD's. *DVD-ROM* (*R*ead-*O*nly *M*emory) stores computer data or programs for use with a computer's DVD-ROM drive. Computer users can employ *DVD-R* (*R*ecordable) and *DVD-RW* (*R*ead/*W*rite) drives to store their own data on special DVD's.

An international group of electronics manufacturers developed DVD. Products that use DVD's first became available in 1996. Ken C. Pohlmann

See also Compact disc (pictures: A DVD).

Dvina River, *dvee NAH,* is the name of two rivers in eastern Europe. One, called the Western Dvina or Daugava, rises west of Moscow in Russia, and flows into the

Gulf of Riga at Riga, Latvia. This river is 633 miles (1,019 kilometers) long.

Another river, the Northern Dvina, is an important waterway in northwestern Russia. The Northern Dvina, formed by the Sukhona and Vychegda rivers, is 455 miles (732 kilometers) long. The Northern Dvina flows into the White Sea at the port of Arkhangelsk. Steamboats travel on the Northern Dvina. It is connected to the Neva and Volga rivers by the Northern Dvina Canal. For location, see **Russia** (terrain map).

Leslie Dienes

Dvořák, *DVAWR zhahk*, **Antonín,** *AN TAW nyeen* (1841-1904), was a Czech composer. He and Bedřich Smetana are considered the founders of the Czech national school of music. Dvořák composed in a variety of musical forms, including songs, *chamber music* (compositions played by small groups), choral works, operas, symphonies, and dances. He is best known for his symphony *From the New World* (1893). This work was his ninth and last symphony. But it is also known as his fifth symphony because Dvořák started numbering his symphonies only after 1880. This symphony is a good example of the non-Germanic romanticism of the late 1800's.

The folk music of the Czechs and other Slavic peoples was the main source of Dvořák's music. Dvořák's songs have passages of powerful dramatic expression and skillful use of melody. His best-known songs include *Moravian Duos* (1876), *Gypsy Melodies* (1880), and *Biblical Songs* (1894). His most famous chamber work is the piano trio *Dumky* (1891). The music in his chamber works, as well as in such orchestral works as the *Carnival* overture (1892), is lyrical and powerful. Dvořák's major choral works include the famous *Stabat Mater* (1876), composed after the death of two of his children; and the oratorio *St. Ludmila* (1886). *Rusalka (The Water-Nymph,* 1900) is considered the best of his several operas.

Dvořák was born in Nelahozeves, a small village near Prague. At the age of 16, he went to Prague to study music. The Czech National Theater was founded in 1862, and Dvořák became a viola player in its orchestra. Dvořák began composing at about the same time. He was his own greatest critic, and, in 1873, he burned the scores of most of the works he had composed.

A performance of the cantata *Hymnus* in 1873 marked the first public performance of a Dvořák work. The composition received great acclaim. Dvořák soon applied for a *stipend* (grant) offered to musicians by the government. He submitted the score of a symphony to support his application. The judges, including Johannes Brahms, were so impressed by the power of Dvořák's music that they granted him a three-year stipend. This occasion also began a lifelong friendship between Brahms and Dvořák. Brahms used his influence to help get Dvořák's compositions published.

In 1878, Dvořák composed the first set of his well-known *Slavonic Dances.* A performance of it in 1879 in London made Dvořák known in England. Beginning in 1884, Dvořák visited England many times to conduct performances of his orchestral and his choral works.

In 1891, Dvořák became professor of musical composition at the Prague Conservatory. His growing fame and the success of his works in the United States brought him an offer to serve as director of the National Conservatory of Music in New York City. Dvořák held this position from 1892 to 1895. At the same time, he conducted, and he visited Czech and other Slavic settlements in the Midwest.

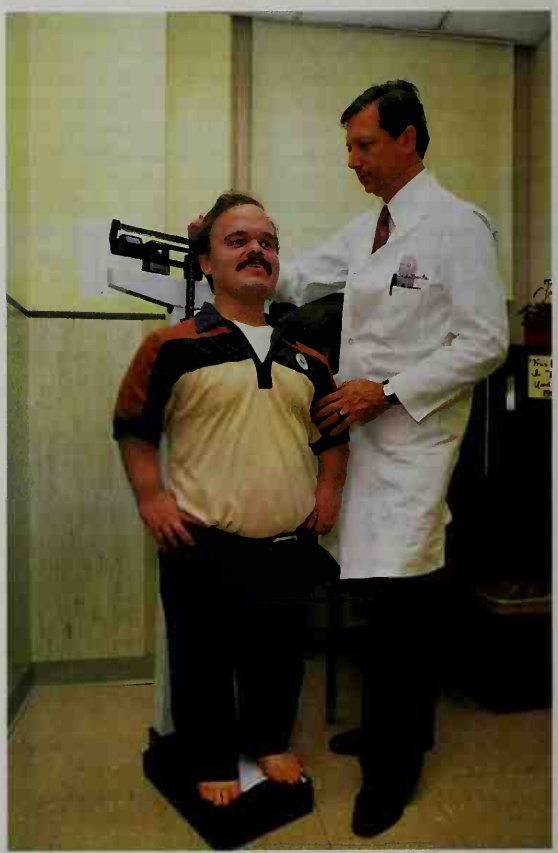
Dvořák composed *From the New World* while living in the United States. Its popular second movement uses the theme of the black American spiritual, "Goin' Home."

Stewart L. Ross

Dwarf is an unusually small adult human being, animal, or plant. Human dwarfs who have normal body proportions are also called *midgets.* Other human dwarfs have abnormal proportions. There are several kinds of dwarf animals, including dwarf cattle and toy dogs. Dwarf plants include ornamental fruit trees and several varieties of flowers, such as marigolds and dahlias.

Dwarfism occurs in individual organisms and in entire groups of organisms. Such groups include African Pygmies, Shetland ponies, and dwarf trees. Dwarfism may result from an inherited defect or from problems that affect a developing baby during pregnancy. A wide variety of diseases, very poor nutrition, or severe emotional deprivation also can interfere with growth.

This article discusses human dwarfism, which occurs as the result of an underdeveloped skeleton. The growth of the bony skeleton depends on the formation of tissue called *cartilage* (see **Cartilage; Bone** [Development of bones]). Dwarfism results when the cartilage cells do not grow and divide properly. Such improper



Margaret Thomas, *The Washington Post*

Dwarfism occurs when the bones' cartilage cells do not grow properly. As a result, such body parts as the arms, legs, and torso may be underdeveloped. This photo shows a dwarf and his physician, who is of normal height.

development may occur because of defective cartilage cells or interference with the growth of otherwise normal cartilage cells. Defective cartilage cells cause *chondrodystrophic dwarfism,* in which the defect is restricted to the cartilage cells, or *chromosome-related dwarfism,* in which there is a more widespread cellular disorder. Interference with the growth of normal cartilage cells results in either *hormonal dwarfism* or *nonhormonal dwarfism.*

Chondrodystrophic dwarfism occurs when only certain cartilage cells are defective. The term *chondrodystrophic* means *badly developed cartilage.* Most chondrodystrophic dwarfs have abnormal body proportions. The defective cells occur only in the spine or only in the arms and legs. Consequently, either the *torso* (chest and abdomen) or the limbs grow unusually short.

Chromosome-related dwarfism results when all the cells of the body are defective. Such defects involve a disturbance in the number of *chromosomes* per cell. The chromosomes are the cell structures that contain *genes.* Genes provide the cell with information on how to grow and divide. Each body cell normally has 46 chromosomes. If a cell has an extra chromosome or is missing a part of a chromosome or a whole chromosome, growth may be affected. One such disorder that results in dwarfism is *Turner's syndrome.*

Hormonal dwarfism may occur when a hormone deficiency interferes with the growth of normal cartilage cells. Hormones are chemical substances secreted by various glands. These substances circulate through the blood and influence cells to act in certain ways.

There are three major hormones or hormonelike substances needed for growth: (1) *growth-hormone-releasing hormone* (GHRH) from the *hypothalamus,* a hormone-producing center in the brain; (2) *growth hormone* (GH) from the pituitary gland; and (3) *somatomedin C,* produced by the liver and probably other tissues, including bone and cartilage. GHRH stimulates the pituitary gland to release GH. GH probably stimulates growth in some cells, but more importantly, it stimulates release of somatomedin C. Somatomedin C can accelerate growth in many types of cells. Extreme emotional neglect or abuse produces a reversible form of dwarfism probably by interfering with one or more of these hormones through effects on the nervous system. Other hormones, including *insulin* from the pancreas and *thyroxine* from the thyroid gland, also influence growth.

An individual with a deficiency of any of the major growth-promoting hormones is usually normally proportioned but much shorter than other members of his or her family. Such individuals appear much younger than their actual age and grow at a slower rate than normal. They reach their final height and may become sexually mature in their mid-20's.

Physicians use GH to stimulate growth in some types of patients with subnormal growth. In the past, GH was extracted from human pituitary glands. Today, it is made in the laboratory by genetic engineering methods.

Nonhormonal dwarfism occurs if disease or severely impaired nourishment blunts the growth of cartilage cells. For example, diseases of the bowel or kidneys may interfere with growth. Many nonhormonal and hormonal interferences with growth can be corrected, with rapid "catch-up" growth taking place after treatment. A child who appears to be growing too slowly should be examined by a physician to determine whether the child's growth is normal. Jesse Roth

See also Bonsai; Pygmies; Shetland pony; Toy dog.

Dwarf star. See Brown dwarf; Star (Evolution of stars; [diagram: The Hertzsprung-Russell diagram]); White dwarf.

Dwight, John (1635?-1703), was an important early English potter. He developed and manufactured high-quality stoneware at his factory in Fulham, now a London suburb. His stoneware led to the establishment of England as a world center for ceramics production.

Dwight was probably born in Oxfordshire. He settled in Fulham between 1671 and 1673. Dwight took out his first patent for stoneware in 1671. The patent was renewed in 1684 for a hard red stoneware that was a great improvement over earlier English ceramics. Dwight improved his stoneware to the point that he was able to use it to make sculptures. These sculptures included small figures of mythological characters and full-sized portrait heads. The heads marked the peak of English ceramic art in the late 1600's. John W. Keefe

Dyaks. See Dayaks.

Dye is a chemical solution used to produce long-lasting colors in materials. The textile industry uses dyes to color fibers, yarns, and fabrics. Manufacturers also dye food, fur, ink, leather, paper, plastics, and wood. This article primarily discusses textile dyeing.

Dyes are made from substances called *dyestuffs.* Until the 1850's, all dyestuffs came from natural sources, such as parts of plants or animals. Today, industry uses synthetic dyestuffs almost entirely. The dyes they produce hold their color better and cost less than natural dyes.

How dyes work

Dyes must be dissolved before they can work. Manufacturers usually mix them with other substances, such as acid or table salt, to make them dissolve. When textiles go into a *dyebath* (dye solution), the fibers absorb the molecules of the dye. The absorbed dye molecules either become trapped within the fibers or chemically bond with the fiber molecules. These dye molecules give the fibers the desired color.

Dyed textiles vary in their ability to hold color. However, all textiles can be made *colorfast* to at least some extent. Many colorfast fabrics resist fading from laundering or sunlight and color changes from such substances as perspiration and chlorine.

To improve the colorfastness of some fabrics, dyers use substances that bond with the dye or fiber molecules, or both. Bonding agents called *mordants* are used mainly on natural fibers, such as cotton, flax, silk, and wool. The chief mordants include tannic acid and soluble compounds of such metals as aluminum, chromium, copper, iron, and tin.

Kinds of dyes

Synthetic dyes. The chief kinds of synthetic dyes include (1) acid dyes, (2) azoic or developed dyes, (3) basic dyes, (4) direct dyes, (5) disperse dyes, (6) fiber reactive dyes, (7) premetalized acid dyes, and (8) sulfur dyes and vat dyes. Pigments are sometimes used to color textiles. But they do not dissolve, and so they are not true dyes. Manufacturers use adhesives to fix pigments to fibers.

Acid dyes are not themselves acidic, but acids must be added to the dye bath to enable the dye to bond with the fiber. Acid dyes are most often used to color nylon, silk, and wool.

Azoic or developed dyes involve a reaction of two colorless chemicals to produce a colored dye in the fiber. Dyers sometimes use this type of dye to produce bright, wash-fast colors in cotton or rayon fabrics.

Basic dyes, also called *cationic dyes,* are dissolved in acid solutions. They are used primarily to dye acrylic and modacrylic fibers. They can produce brilliant colors.

Direct dyes were the first dyes that could color fibers without the help of a mordant. Table salt helps control the dyeing process and achieve deep shades. Dyers use direct dyes on cotton, flax, and certain rayons.

Disperse dyes dissolve only slightly in water. They are used to color acetate, acrylic, nylon, and polyester. To dye these fibers, dyers must use heat. The high temperature causes the fibers to swell, which enables the dye to pass into the fiber.

Fiber reactive dyes form a strong chemical bond with certain fibers, including cotton and rayon. Some types can also color nylon and wool. Fiber reactive dyes produce wash-fast colors, often in bright shades.

Premetalized acid dyes contain such metals as copper and chromium, which improve colorfastness. Such dyes are widely used on nylon and wool.

Sulfur dyes and vat dyes are insoluble in water, but when put in an alkaline solution, a chemical reaction enables them to dissolve. Fibers colored with such dyes are then exposed to air to develop their true color and to help fix the dyes. Vat dyes rank among the most colorfast dyes. Sulfur dyes and vat dyes are used chiefly on cotton and rayon.

Cone Mills Corporation

In yarn dyeing, fibers are dyed after they are made into yarn. Denim yarn is dyed by being pulled through large vats of indigo blue dye, *shown here.*

Natural dyes. Most natural dyes came from such parts of plants as the bark, berries, flowers, leaves, and roots. The madder plant, which grows in Asia and Europe, supplied bright red dyes for many fabrics, including linen and silk. People in many lands obtained *saffron,* a yellow dye, from the crocus plant. They used it on such textiles as silk and wool. Natural *indigo,* a dark blue dye, comes from the indigo plant, which grows chiefly in India. Dyers used it on cotton, wool, and other fibers, and still use it on denim fabrics. *Logwood* comes from a tree that grows in Central America, Mexico, and the West Indies. It supplies black and brown dyes for such materials as cotton, fur, and silk. *Henna,* an orange-brown dye made from a shrub of North Africa and the Middle East, was used to color leather. Today, people sometimes use henna to dye their hair or skin.

Leading animal dyes included *carmine* and *Tyrian purple.* Carmine, a bright red dye, was made from the dried bodies of an insect found in Mexico and Central America. Tyrian purple, a rare, expensive dye, came from certain shellfish of the Aegean and Mediterranean seas.

Dyeing textiles

Textile manufacturers dye fibers and fabrics at various stages. If manufacturers dye the fibers before spinning them into yarn, the process is called *stock dyeing.* In *yarn dyeing,* also called *skein dyeing,* the fibers are dyed after they are made into yarn. In *piece dyeing,* which is used for most solid-color fabrics, manufacturers apply the dyes after the yarn is made into cloth. Some dyeing machines pull the fabric through the dyebath. Others have *squeeze rolls* that force dye into the cloth. Some machines can continuously dye about 100 yards (90 meters) of fabric per minute. Manufacturers print designs on some fabrics. A machine applies different colors to various areas by means of screens or engraved rolls. See **Screen printing; Textile.**

History

People have used dyes to color fabrics and other materials for more than 5,000 years. In addition, dyers have made use of mordants for several thousand years.

In 1856, William H. Perkin, an English chemist, made the first synthetic dye. This dye, called *mauve,* is pale purple. Perkin produced it accidentally when he tried to make quinine from a coal-tar product called aniline.

Before World War I (1914-1918), Germany made most of the world's dyes. During the war, the Germans cut off their supply of dyes. As a result, dye industries in other industrialized countries grew rapidly. Since the 1940's, chemists have invented many synthetic textile fibers—and have developed thousands of synthetic dyes to combine with them.

Robert J. Beaulieu

Related articles in *World Book* include:

Aniline
Batik
Catechu
Coal tar
Color
Henna
Indigo
Lake (dye)
Leather (Final processing)
Logwood
Madder
Mauve
Mordant
Saffron
Stain
Tie dyeing
Turmeric

Dyer, Mary (? -1660), a colonist from England, became a *martyr* (one who dies for religious beliefs) for the

Quaker faith. With her husband, William, she arrived in Massachusetts about 1635. Because of religious intolerance, the couple later moved to Rhode Island.

In 1652, Mary Dyer returned to England and joined the Society of Friends, or Quakers. In 1657, she came back to America. She was arrested repeatedly for "bearing witness to her faith." Finally, in Boston, she was convicted of *sedition* (causing rebellion) and hanged.

Fred W. Anderson

Dylan, *DIHL uhn,* **Bob** (1941-), an American composer, singer, and musician, was the most influential folk-song writer of the early 1960's. His early songs often protested what many people considered the wrongs of society. These early songs include "Blowin' in the Wind" (1962) and "The Times They Are A-Changin" (1963). One of Dylan's biggest hits was "Like a Rolling Stone" (1965).

Dylan was born on May 24, 1941, in Duluth, Minnesota. His given and family name was Robert Allen Zimmerman. In 1961, he moved to New York City to meet his idol, folk singer Woody Guthrie. At first, Dylan accompanied himself on acoustical guitar and harmonica. In the mid-1960's, he formed a rock band that used electric guitars. In the late 1960's and early 1970's, Dylan moved toward country music. In the late 1970's, he wrote Christian music. Dylan mixed spiritual and nonreligious themes in the 1980's. In the early 1990's, Dylan returned to his folk roots, recording two solo acoustic albums. His folk album *Time Out of Mind* (1997) won two Grammy awards. Dylan's "Things Have Changed" from the motion picture *Wonder Boys* won the 2000 Academy Award as best song. His *Love and Theft* won the 2002 Grammy for contemporary folk album. Don McLeese

Dynamics, *dy NAM ihks,* in physics, is the study of objects that change their speed or the direction of their motion because of forces acting upon them. Sir Isaac Newton expressed the relationship of these forces and changes in motion in his second law of motion. This law states that the force applied to an object is equal to the mass of that object multiplied by its acceleration in the direction of the force (see **Force** [Characteristics of force]; **Motion** [Newton's laws of motion]). See also **Mechanics; Statics.** James D. Chalupnik

Dynamite is an important industrial explosive. It has been used to blast out damsites, canal beds, mines, quarries, and the foundations for large buildings. Dynamite also has been used for demolition in warfare.

The principal explosive in dynamite is an oily liquid called *nitroglycerin.* It is mixed with other materials—some explosive and some nonexplosive—and packed in cylinders made of waxed paper or plastics. These cylinders, called *cartridges,* range from $\frac{7}{8}$ to 8 inches (22 to 200 millimeters) in diameter and from 4 to 30 inches (10 to 76 centimeters) in length.

To use dynamite, workers insert an explosive device called a *detonating cap* or *blasting cap* into one end of the cartridge. They place the cartridge in a hole bored into the material to be blasted. Earth is packed around and behind the cartridge. After moving to safety, the workers set off the detonating cap—and the explosion—by means of a fuse or an electric current.

Kinds of dynamite. There are four chief varieties of dynamite. They are (1) *straight dynamite,* (2) *ammonia dynamite,* (3) *straight gelatin,* and (4) *ammonia gelatin.*

Straight dynamite contains nitroglycerin and an absorbent, chemically reactive mixture, such as wood pulp and sodium nitrate. It is the oldest dynamite type and has been replaced by ammonia dynamite for most uses.

© David R. Frazier

Dynamite has many industrial uses. This silver miner is placing cartridges of the explosive in holes drilled in the mine.

Ammonia dynamite is stronger, safer, and cheaper than straight dynamite. It contains ammonium nitrate and produces cooler gases and fewer toxic fumes than other dynamites do. It is called a *permissible explosive,* which means that it can be used safely in mines where extreme heat could ignite dust or gas in the air.

Straight gelatin is made from a stiff gel called *blasting gelatin.* Blasting gelatin consists of nitroglycerin mixed with a small amount of an explosive called *guncotton* (see **Guncotton**). Sodium nitrate and other ingredients are added to make straight gelatin. Ammonia gelatin has replaced straight gelatin for most uses.

Ammonia gelatin is made by adding ammonium nitrate and other ingredients to blasting gelatin. Ammonia gelatin is waterproof. It is used for underwater and hard-rock blasting.

History. Dynamite was patented in 1867 by Alfred Nobel, a Swedish chemist and founder of the Nobel Prizes. Nobel discovered that *kieselguhr,* a type of chalky earth, absorbed a great deal of nitroglycerin. He found that kieselguhr soaked with nitroglycerin served as an explosive that was less dangerous to handle than pure nitroglycerin. It also was more powerful than the gunpowder explosives then used for blasting. From his discovery, Nobel developed straight dynamite and blasting gelatin.

In the early 1900's, ammonia dynamite and ammonia gelatin were developed. In the 1950's, many blasting operators began to prefer a mixture of ammonium nitrate and fuel oil, called ANFO, to dynamite. They also used *slurry explosives,* which are slushy mixtures of chemicals called *nitrocarbonitrates.* ANFO and slurry explosives are the most widely used industrial explosives today. They are cheaper than dynamite but need dynamite or other explosives to detonate them. James E. Kennedy

See also **Explosive; Fuse; Nitroglycerin; Nobel, Alfred B.; TNT.**

Dynamo. See **Electric generator.**

Dyne, *dyn,* is a unit of force. It is the force that acting upon 1 gram of matter will give it an acceleration of 1

centimeter per second for every second the force acts (1 centimeter per second per second). The dyne is part of the *centimeter-gram-second* (CGS) system, an early version of the metric system. In the present metric system, called the *International System of Units* (SI), the *newton* is used instead of the dyne to measure force (see **Newton**). The dyne corresponds to the *poundal* in the inch-pound system of measurement customarily used in the United States. Leland F. Webb

Dysentery, *DIHS uhn TEHR ee,* is a disease involving inflammation of the lining of the large intestine. The inflammation, which is caused by microscopic organisms, produces abdominal pain and diarrhea. The bowel movements may contain mucus and blood. Some cases of dysentery include fever or vomiting.

Diarrhea causes people with dysentery to lose fluids and salts necessary to their bodies. The disease can be fatal if the body becomes dehydrated. Dysentery strikes people of all ages throughout the world, but some forms occur more frequently in tropical countries. It can be particularly dangerous to infants, the elderly, and people in weak physical condition.

Dysentery is caused by several types of microorganisms, including *salmonella* bacteria, *shigella* bacteria, and one-celled organisms called *amebas.* Shigella and amebas cause most dysentery. Shigella produce *shigellosis,* also called *bacillary dysentery.* Shigellosis begins suddenly and involves high fever and severe diarrhea. If untreated, the disease may disappear in a few weeks. But some cases result in fatal dehydration.

Amebas cause *amebic dysentery,* which begins gradually and rarely produces high fever. It can cause diarrhea for years, however, and may produce *ulcers* (open sores) in the large intestine. Later, the infection may spread to the liver. Amebic dysentery seldom is fatal.

The organisms that cause dysentery are transmitted through the *feces* (solid body wastes) of infected individuals. Some people, known as *carriers,* spread the disease but have no symptoms of it.

The bacteria and amebas enter the body through the mouth, in most cases in food or water. Flies and unwashed hands can transfer feces to food. Fruits and vegetables must be thoroughly washed if they have been treated with fertilizer containing human feces.

Epidemics of dysentery have occurred where people live in overcrowded conditions and have poor sanitation. In the past, the disease was common in hospitals, prisons, and army camps. During some wars, more soldiers died from dysentery than in battle. Improved sanitation during the 1900's greatly reduced the number of cases. However, epidemics of the disease still occur in less developed countries. Treatment includes replacing fluids and body salts that the patient has lost. Physicians also use certain antibiotics to speed recovery from dysentery. James L. Franklin

Dyslexia, *dihs LEHK see uh,* is a severe reading difficulty that continues despite years of reading instruction. Many cases of dyslexia are diagnosed when the affected person is about 10 years old. Most 10-year-olds can read textbooks, stories, and parts of newspapers. But a 10-year-old with dyslexia may not be able to read more than a few words or read even simple sentences.

The term *dyslexia* is used chiefly by physicians and a few educators. Most educators and psychologists describe people with such problems as being *reading disabled.* Special-education teachers, on the other hand, refer to such problem readers as *learning disabled.*

Scientists have studied dyslexia since the 1890's, but its cause is still unknown. Nevertheless, experts do know that many more boys than girls are diagnosed as dyslexic. Dyslexic children generally have average or above average intelligence. They also do not differ significantly from normal learners in their ability to see, hear, or speak. People with dyslexia often confuse letters or words and may read or write words or sentences in the wrong order. But this confusion results from an inability to identify the distinguishing characteristics of letters and words and is not due to general problems of visual perception. The exact causes of dyslexia are not known. Many scientists believe that dyslexia is the result of numerous factors, including the action of genes and the way the brain is "wired," or organized.

Identifying a child as dyslexic generally requires a diagnostic evaluation by a reading specialist. The diagnosis usually includes the development of a case history of the child by obtaining information from family members and professionals who know the child. These professionals may include teachers, a school psychologist, and a family physician. The diagnosis also involves ruling out other possible causes of the reading difficulty, including poor eyesight or hearing. Treatment of dyslexia usually consists of small-group or individual reading instruction by a specially trained professional. Michael W. Kibby

Additional resources

Donnelly, Karen. *Coping with Dyslexia.* Rosen Pub. Group, 2000.
Hurford, Daphne M. *To Read or Not to Read: Answers to All Your Questions About Dyslexia.* Scribner, 1998.
Moragne, Wendy. *Dyslexia.* Millbrook, 1997.

Dyspepsia, *dihs PEHP see uh,* is a term that is loosely used to refer to a disorder in digestion. Dyspepsia involves such symptoms as pain in the upper abdomen, heartburn, belching, fullness and heaviness in the stomach region, and spitting up food or sour-tasting liquid. Dyspepsia may be caused by ulcers of the stomach or duodenum, hyperacidity, cancer of the stomach, gallstones, infection of the gallbladder, colitis, constipation, adhesions, chronic appendicitis, and worry and nervousness. It can be treated only by treating the disorder that is causing it. In many cases, proper diet is part of the treatment. See also **Indigestion.** Andrew G. Plaut

Dysprosium, *dihs PROH see uhm* (chemical symbol, Dy), is one of the rare-earth metals. Its atomic number is 66, and its atomic weight is 162.50. Its density is 8.559 grams per cubic centimeter at 25 °C (see **Density**). Dysprosium has a melting point of 1412 °C and a boiling point of 2567 °C. The name comes from the Greek word *dysprositos,* meaning *hard to get.* French scientist Paul Émile Lecoq de Boisbaudran discovered dysprosium in 1886. It is found associated with erbium, holmium, and other rare earths in the minerals gadolinite, euxenite, xenotime, and others. Dysprosium is best separated from the other rare earths by solvent extraction or ion-exchange processes (see **Ion**). When cooled to low temperatures, it is strongly attracted by a magnet.

Larry C. Thompson

See also **Rare earth.**

Dystrophy, Muscular. See **Muscular dystrophy.**

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